

# LLOYDIA

## *A Quarterly Journal of Biological Science*

Published by the Lloyd Library and Museum, Cincinnati, Ohio

---

### A Nomenclatorial Survey of the Genera of Pore Fungi

WM. BRIDGE COOKE

(Mount Shasta, California)

In 1903 Murrill (20) published a paper in which he reviewed the history of the genera of pore fungi known up to that time. In his paper Murrill considered all genera dating back to the time of Linnaeus. This was required, of course, by the American Code of botanical nomenclature. Since the time of Murrill's historical paper about twice as many genera have been published and, at least in more radical schools of taxonomy, some of the pre-Friesian genera are still in use. To correct this situation and to bring the list of pore genera into conformity with the latest revision of the International Code of botanical nomenclature (36) the present problem was undertaken under Dr. Donald P. Rogers at Oregon State College. Suggestions have been added by Dr. G. W. Martin. A nearly complete survey of the literature was made. The libraries of Oregon State College, the University of California, the State University of Iowa, and the Lloyd Library were used extensively.

For more than seventy years mycologists working with the group of fungi commonly included in the *Polyporaceae* have had considerable difficulty in recognizing lines of division between genera in this group.\* Fries, between 1821 and 1874 (1, 3, 4, 5, 6), published fourteen genera considered standard in the *Polyporaceae* by workers in general. However, there has been a tendency recently to stress hymenial and microscopic characters in the classification of this group. This has resulted in the recognition of genera other than the original few. Because of their obvious relationship with other groups genera such as *Merulius*, *Solenia* and *Porothelium* are removed to other families, e.g., *Meruliaceae* [Murrill's untenable *Zygophylaceae* (19)], and *Thelephoraceae*.

From the time of Karsten (1879) to the present the Friesian genera have been modified in one way or another. Prior to 1879 Karsten followed con-

---

\* To the writer this will always be an important problem involving the critical ideas of each different monographer. An easy solution of the problem would be reversion to the single genus *Polyporus* Fries.

ventional lines. In fact, in his first publication he recognized only three genera, *Merulius*, *Polyporus* and *Daedalea*. From 1879, however, he recognized more and more lines of division between species placed in Fries's *Polyporus*, as well as between species in other overloaded genera of fungi.

There seem to have been three principal schools of nomenclature in the group as a whole. (The *Boletaceae* and the *Meruliaceae* are not fully considered here.)

1. The Conservatives. The members of this group follow Fries in general. They take into account only the major modifications of sporophore and hymenium. The ultra-conservative is Cunningham (29) who recognizes only six genera, including *Merulius*. Thus his synonymy list is most imposing. Other conservatives include M. C. Cooke (10), Winter (11), Saccardo (14), Lloyd (17), Neuman (23), Overholts (24, 34), Rea (27), Killermann (31), Shope (32) and Lowe (35). All these recognize up to fifteen genera in the group including genera transferable to other families on the basis of various characters. The works of these authorities are those most commonly used by the beginner because they are generally considered to be the easiest to use. That a pore fungus is a *Polyporus* is one of the easiest points for a beginner to grasp. That all members of the *Agaricaceae* have gills as in *Agaricus* is a point equally easy to put across.

2. The Radicals. In this group I am putting all writers from the time of Karsten who dared to propose one or more genera in which to place segregates of Friesian genera which to them seemed unwieldy. Some have gone farther than others and the best example of the group is Murrill (21) who drew together more than seventy genera, including many of his own, to take the place of about ten Friesian genera. Torrend (26) comes under this heading. He monographed the Brazilian species of stipitate polypores, following Lloyd, but elevating Lloyd's subgenera to generic rank. Lazaro (25) inexcusably manufactured a lot of Spanish genera of which probably none are good. Karsten (8, 9) added many genera to the list. In addition to the cited works Karsten added many in short papers and to my knowledge never compiled the whole in one short paper or book after 1881 (9). Next to Murrill he was the greatest splitter. Quélet (12), Schroeter (15), Kuntze (16), and Patouillard (13, 18) also come under this heading.

3. The Middle of the Road. In this group fall those who, while they may have proposed a few new genera, still were more or less conservative in handling the bulk of the genera they could have used. Trotter (28) falls here only because he was a compiler. If he had had more time to bother checking some of the genera he used in Vol. 23 of the *Sylloge* his list would have been reduced to the point where he could be considered a conservative. Ames (22) did an excellent piece of work in defining her idea of the generic position of some one hundred species of polypores. Her work is not completely conservative because it goes beyond the Friesian system and



because she did not take into account all the possibilities, for one hundred species is not a large proportion of the group. Bourdot and Galzin (30) took a middle road following Patouillard, many of whose genera they reduced to synonymy. The writer prefers to keep several of these separate. Donk (33), again, follows Bourdot and Galzin, Patouillard and others but in a way peculiar to Donk, in a number of cases disregarding the International Rules. He also lumps some things and segregates others, discarding genera the writer feels are valid and adding genera the writer feels are not valid.

The generic list which follows is divided into a number of sections. A large number of the two hundred and nineteen genera considered were discarded. The fact that some have been discarded as synonymous with other genera does not eliminate them from becoming validated at another time. For instance, while we consider *Ungulina* Pat., a section of *Ganoderma* Karst., in which the colorless spores are truncate, another worker may think it distinct enough from other species placed in *Ganoderma* Karst. to restore *Ungulina* Pat. to generic rank; or another worker may prove that the sterile cup which gives rise to the sporophore of *Poronidulus* Murrill sufficient evidence upon which to re-elevate this genus to generic rank from subgeneric rank in *Coriolus* Quél. where it now rests.

Pre-Friesian genera are automatically eliminated on the basis of the nomenclatorial starting point rule in the code. However, S. F. Gray (2) is considered published later in the year 1821 than the first volume of Fries (1) and his genera are thus valid, unless invalidated on other grounds.

Likewise, on the basis of the rules, nomina nuda, teratologic genera, and homonyms are discarded.

We have here considered four types of genera valid. First is a small group of genera described from European material. Studies of type material, if in existence, should be made of this group, after which some may be discarded. The second group includes those pore fungi in which a close relationship to other families is indicated. Some representatives of *Laschia* Fries undoubtedly belong to the *Auriculariaceae*. Most of the other gelatinous groups in which the hymenium is continuous over the pore surface, but in which the hymenium is still in folds, belong in a separate family, or subfamily of equal rank with other families or subfamilies containing pore fungi in the Patouillardian groups *Aphyllophorales* or *Aphyllophoraceae* (18, 28, 33). *Solenia* and *Porothelium* are placed with what are now referred to as the *Thelephoraceae*. Some of these families or subfamilies show, in the type of pore or fold in the hymenium, a possible source of the true pore fungi, others show possible parallel development.

A number of genera have been described from tropical North America, including southern Florida (Murrill's Oligocene Island), Mexico, the Caribbean Islands, and from South America, Africa, Australia, the Philip-pines, etc. These are not yet known to the writer, who prefers, at least at

present, to leave their destiny in the hands of persons familiar with the mycobiota of the areas involved.

The valid genera of North America, north of Mexico and Southern Florida, have been considered in the light of Murrill (21), Ames (22), Donk (33), and others. Of the forty-six genera included in List I, and in the key, the writer has seen or collected representatives of forty-two. Except for color of spores, and setae and cystidia on the hymenium, the characters used to differentiate the genera are more or less superficial, at least they are largely macroscopic. However, they are, at present, thought to be at least as fundamental as the characters used to differentiate between the numerous segregates of the genus *Agaricus* Fries which is polymorphic in the same way that *Polyporus* Fries is polymorphic, but which has been studied more intensively partly, at least, because of the interest of mycophagists which can be exercised in the case of only a few of the pore fungi excepting the *Boletaceae*.

In the 1935 edition of the International Rules of botanical nomenclature (36) four genera of *Polyporaceae* are proposed for conservation over six others. An analysis of this situation follows. First we shall quote the proposals:

Proposed for Conservation

*Hymenogramme* Berk. & Mont. Decad. Fung.  
in: Hooker, Lond. Journ. Bot. III. (1844)  
238. T.: *H. javensis* B. & M.

*Hexagona* Fr. Epicr. (1836-38) 496 (non *Hexagonia* Poll. Pl. nov. (1819) 35) T.: *H. apiaria* Fr.

*Poria* (Fr. Nov. Symb. (1851) 70, subgen.)  
Karst. Rev. Myc. III. (1881) 19, emend  
Sacc. Syll. VI. (1888) 292.—T.: *P. vulgaris*  
(Fr. Syst. Myc. I: 381, sub Polyporo) Sacc.

*Porodisculus* Murrill, N. Am. Flor. IX (1907)  
47.—T.: *P. pendulus* (Schw. Schr. Nat. Ges.  
Leipz. I, 92, sub *Peziza*) Murr.

Proposed for Rejection

*Aschersonia* Endl. Gen. Pl. Suppl. II (1842).  
103.

*Junghuhnina* Corda, Anleit. (1842) 195.

*Laschia* Junghuhn, Praem. Fl. Krypt. Javae  
(1839) 75, non Fr. (1830).

*Scenidium* (Klotzsch, Linnaea VII (1832) 200  
subgen.) O. Kuntze Rev. II (1893) 515.

*Physisporus* Gill. Champ. France (1874-77)  
693.

*Enslinia* Fr. Summ. Veg. Scand. (1849) 399  
(non *Enslinia* Rchb. Consp. (1828) 131—  
*Enslenia* Nutt. Gen. Am. I (1818) 164).

Of these the first, second and fourth would seem unnecessary for consideration for the following reasons:

1. *Laschia* Jungh. 1839 is a homonym of *Laschia* Fries 1830. Corda, in 1842, proposed *Junghuhnina* to relieve the situation. Endlicher, also in 1842 but a few months earlier, proposed *Aschersonia* as a generic name to replace *Laschia* Jungh. On closer study of Endlicher's proposal it appears that his publication is not necessarily valid since, although he quoted Junghuhn's original description of *Laschia* Jungh., he did not include any species in his new genus although he cited the bibliographic reference to Junghuhn's article. Because of this, those who have been in the habit of



using *Aschersonia* Mont. 1856 for a genus of the *Nectrioideae* probably may continue to do so validly. Since Corda quoted species as well as the original diagnosis in his *Junghuhnia* this is the name which will probably best be used for the complex of species of gelatinous porose fungi. Berkeley and Montagne, in 1844, proposed *Hymenogramme* for additional species of the *Laschia* Junghuhn complex, according to Saccardo (20). Thus conserving *Hymenogramme* over *Junghuhnia* seems to me undesirable if, indeed, these species are distinct from *Laschia* Fries. It seems that this complex is in urgent need of monographic treatment.

2. *Hexagona* Fries is suggested for conservation over *Scenidium* (Klotzsch) O. Kuntze. It seems obvious to me that *Scenidium* O.K. would be automatically placed in synonymy with *Hexagona* Fr. eliminating any necessity for conservation of the latter genus.

4. *Enslinia* Fries, being a homonym of *Enslinia* Rchb., is automatically rejected as a valid generic name. Thus *Porodisculus* Murrill remains valid without conservation.

Concerning 3. *Poria* there is some argument as to the valid use of the name. Donk (33) felt that since there is no type material available for study the genus should be discarded. In any event he used it merely as a form genus, the use to which it has been put by many workers who use it as a catch-all for all resupinate polypores, or for any resupinate polypore for which reflexion cannot be proved. S. F. Gray (2) used the name for seven species including *P. vulgaris* and *P. medularia*. In this paper we are considering S. F. Gray as having been published later than the first volume of Fries. Thus *Poria* [Pers.] S. F. Gray is valid and conservation of the above mentioned genus becomes unnecessary. Miss Wakefield, in the July 1939 Transactions of the British Mycological Society 23: 226 presents arguments for conservation of Cooke's rather than Saccardo's emended *Poria* (Fries) Karsten. We have been able to find one other early use of the word, or its plural, in the literature. L. Secretan in Vol. 3 of *Mycographie Suisse*, issued in 1833, on page 174 uses the generic name "*Poriae*" for a group of five resupinate polypores. This may not be a valid use of the name but cannot be completely ignored.

In selection of types, in the following discussion, the "first species rule" has for the most part been used except where the author of the genus, or a competent monographer, specifically mentions a type species.

### Lists of Recognized Genera

#### I. GENERA CONSIDERED VALID WHICH ARE FOUND IN NORTH AMERICA

1. *Abortiporus* Murrill, Torr. Bot. Cl. Bull. 31: 422. 1904.

Based on *Boletus distortus* Schw.

2. *Albatrellus* Mich. ex S. F. Gray, Nat. Arr. Brit. Pl. 1: 645. 1821.

Based on *Boletus albidus* Pers. (*P. ovinus* Schaeff, ex Fr.)

3. *Aurantiporellus* Murrill, Torr. Bot. Cl. Bull. **32**: 486. 1905.  
Based on *Polyporus alboluteus* E. & E.
4. *Bjerkandera* Karst., Soc. Faun. Fl. Fenn. Medd. **5**: 38. 1879.  
Based on *Boletus adustus* Willd.
5. *Boletopsis* Fayod, Malp. **3**: 72. 1889.  
Based on *Boletus leucomelas* Pers.
6. *Cerrena* Mich. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 649. 1821.  
Based on *Boletus unicolor* Bull.
7. *Cerrenella* Murrill, Torr. Bot. Cl. Bull. **32**: 361. 1905.  
Based on *Irpex tabacinus* B. & C.
8. *Coltricia* Mich. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821.  
Based on *C. connata* S. F. Gray. (*P. perennis* L. ex Fr.)
9. *Coriolus* Quélet, Ench. Fung. 175. 1886.  
Based on *Polyporus zonatus* Fr.
10. *Cryptoporus* (Peck) Hubbard, Canad. Ent. **24**: 250. 1892.  
Based on *Polyporus volvatus* Peck.
11. *Cyclomyces* Fries, Linnaea **5**: 512. 1830.  
Based on *C. fuscus* Fr.
12. *Daedalea* Pers. ex Fries, Syst. Myc. **1**: 331. 1821.  
Based on *D. maxima* Fr. (stipitate section) or  
*D. Quercina* Fr. (dimidiate section).
13. *Daedaleopsis* Schroeter, Krypt. Fl. Schles. **3**: 492. 1889.  
Based on *Daedalea confragosa* Pers.
14. *Favolus* Fries, Elenchus Fungorum 44. 1828.  
Based on *F. braziliensis* Fr.
15. *Fistulina* Bull. ex Fries, Syst. Myc. **1**: 396. 1821.  
Based on *Fistulina hepatica* (Huds.) Fr.
16. *Fomes* Kickx, Flore Cryptogamique des Flandres **2**: 237. 1867.  
Based on *Boletus fomentarius* L.
17. *Fomitiporia* Murrill, N. Am. Fl. **9**: 7. 1907.  
Based on *F. Langloisii* Murrill.
18. *Funalia* Pat., Ess. Taxon. 95. 1900.  
Based on *Polyporus mons-veneris* Jungh.
19. *Ganoderma* Karst., Rev. Myc. **3**: 17. 1881.  
Based on *Boletus lucidus* Leyss.
20. *Globifomes* Murrill, Torr. Bot. Cl. Bull. **31**: 424. 1904.  
Based on *Boletus graveolens* Schw.
21. *Gloeophyllum* Karst., Hattsv. **2**: x, 79, 1879.  
Based on *Agaricus sepiarius* L.
22. *Gloeoporus* Mont., Ann. Sci. Nat. Bot. Sér. 2. **17**: 126. 1842.  
Based on *Gloeoporus conchoides* Mont.
23. *Grifola* Mich. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 643. 1821.  
Based on *Boletus frondosus* Schrank.



24. *Hapalopilus* Karst., Rev. Myc. **3**: 18. 1881.  
Based on *Polyporus nidulans* Fr.
25. *Hydnochaete* Bres., Hedw. **35**: 287. 1896.  
Based on *H. badia* Bres.
26. *Inonotus* Karst., Soc. Faun. Fl. Fenn. Medd. **5**: 39. 1880.  
Based on *Boletus cuticularis* Bull.
27. *Irpex* Fries, Elenchus Fungorum 142. 1828.  
Based on *I. pendulus* Fr.
28. *Ischnoderma* Karst., Soc. Faun. Fl. Fenn. Medd. **5**: 38. 1880.  
Based on *Boletus resinosus* Schrad.
29. *Laetiporus* Murrill, Torr. Bot. Cl. Bull. **31**: 607. 1904.  
Based on *Boletus sulphureus* Bull.
30. *Lenzites* Fries, Epicrisis. 403. 1838.  
Based on *L. applanata* Fr.
31. *Melanoporia* Murrill, N. Am. Fl. **9**: 14. 1907.  
Based on *Polyporus niger* Berk.
32. *Oxyporus* Donk, Rev. **2**: 202. 1933.  
Based on *Boletus populinus* Schum.
33. *Phellinus* Quél., Ench. Fung. 172. 1886.  
Based on *Agaricus igniarius* Batt.
34. *Physisporus* Chev., Flor. Par. **1**: 261. 1836.  
Based on *Boletus obliquus* Pers.
35. *Piptoporus* Karst., Soc. Faun. Fl. Fenn. Medd. **6**: 9. 1881.  
Based on *Agaricus suberosus* L.
36. *Podoporia* Karst., Hedw. **31**: 297. 1892.  
Based on *P. confluens* Karst.
37. *Pogonomyces* Murrill, Torr. Bot. Cl. Bull. **31**: 609. 1904.  
Based on *Boletus hydnoides* Schw.
38. *Polyporus* Mich. ex Fries, Syst. Myc. **1**: 341. 1821.  
Based on *Boletus squamosus* Huds.
39. *Poria* Pers. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 639. 1821.  
Based on *Polyporus vulgaris* Fr.
40. *Porodaedalea* Murrill, Torr. Bot. Cl. Bull. **32**: 367. 1905.  
Based on *Daedalea Pini* Fr.
41. *Porodisculus* Murrill, N. Am. Fl. **9**: 47. 1907.  
Based on *Peziza pendula* Schw.
42. *Pycnoporus* Karst., Rev. Myc. **3**: 18. 1881.  
Based on *Boletus cinnabarinus* Jacq.
43. *Spongipellis* Pat., Hym. Eur. 137. 1887.  
Based on *Boletus spumeus* Sow.
44. *Spongiporus* Murrill, Torr. Bot. Cl. Bull. **32**: 474. 1905.  
Based on *Polyporus leucospongia* Cooke & Harkn.

45. *Trametes* Fries, *Epicrisis*. 488. 1838.  
Based on *T. Benzoina* Fr.
46. *Tyromyces* Karst., *Rev. Myc.* 3: 17. 1881.  
Based on *Polyporus chioneus* Fries.

## II. GENERA OF THE TROPICS AND SOUTHERN HEMISPHERE

47. *Amauroderma* Murrill, *Torr. Bot. Cl. Bull.* 32: 366. 1905.  
Based on *Fomes regulicolor* Cooke.
48. *Corioloopsis* Murrill, *Torr. Bot. Cl. Bull.* 32: 358. 1905.  
Based on *Polyporus occidentalis* Klotzsch.
49. *Dictyopanus* Pat., *Ess. Taxon.* 137. 1900.  
Based on *Fomes rhippidium* Berk.
50. *Earliella* Murrill, *Torr. Bot. Cl. Bull.* 32: 478. 1905.  
Based on *E. cubensis* Murrill.
51. *Elmeria* Bres., *Hedw.* 51: 317. 1911.  
Based on *Poria setulosa* P. Henn.
52. *Flaviporus* Murrill, *Torr. Bot. Cl. Bull.* 32: 360. 1905.  
Based on *Polyporus rufostavus* B. & C.
53. *Fomitella* Murrill, *Torr. Bot. Cl. Bull.* 32: 365. 1905.  
Based on *Polyporus supina* Sw. ex Fr.
54. *Hexagona* Fries, *Epicrisis*. 496. 1838.  
Based on *H. apiaria* Fr.
55. *Laccocephalum* McAlpine & Tepper, *R. Soc. Victoria Proc. n. s.* 7: 166. 1895.  
Based on *L. basilopiloides* McAlp. & Tepp.
56. *Nigrofomes* Murrill, *Torr. Bot. Cl. Bull.* 31: 425. 1904.  
Based on *Polyporus melanoporus* Mont.
57. *Nigroporus* Murrill, *Torr. Bot. Cl. Bull.* 32: 361. 1905.  
Based on *Polyporus vinosus* Berk.
58. *Phacoloopsis* Murrill, *Torr. Bot. Cl. Bull.* 32: 489. 1905.  
Based on *Polyporus verae-crucis* Berk.
59. *Pseudofavolus* Pat., *Ess. Taxon.* 80. 1900.  
Based on *Hexagona Miquelii* Mont.
60. *Rigidiporus* Murrill, *Torr. Bot. Cl. Bull.* 32: 478. 1905.  
Based on *Polyporus micromegas* Mont.
61. *Rodwaya* H. & P. Sydow, *Hedwigia Beiblatt* 40(1): 2. 1901.  
Based on *Campbellia infundibuliformis* Cooke & Massee
62. *Tomentifolium* Murrill, *Journ. Myc.* 9: 94. 1903.  
Based on *Tilotus lenziformis* Kalchb.
63. *Tomophagus* Murrill, *Torreya* 5: 197. 1905.  
Based on *Polyporus colossus* Fries.
64. *Trichaptum* Murrill, *Torr. Bot. Cl. Bull.* 31: 608. 1904.  
Based on *Polyporus trichomallus* Berk. & Mont.



65. *Whitfordia* Murrill, Torr. Bot. Cl. Bull. **35**: 407. 1908.  
Based on *Fomes Warburgianum* P. Henn.

## III. GENERA INCOMPLETELY KNOWN

(At least some may later be transferred to list VII)

66. *Henningsia* Möll., Protobasid. 44. 1895.  
Based on *H. geminella* Möll.  
67. *Phylloporus* Quél., Fl. Mycol. Fr. 409. 1888.  
Based on *P. pelletieri* (Lév.)  
68. *Poroptycha* Beck, Zool. Bot. Ges. Wien Verh. **38**: 657. 1887.  
Based on *P. candida* Beck.  
69. *Theleporus* Fries, Hornsch. Skand. Beitr. **2**: 338. 1847.  
Based on *T. cretaceus* Fr.

## IV. GENERA OF FUNGI BEARING PORES

or pore-like structures, which are classed in other groups because of radical differences in characters other than superficial pores. Included here for purposes of clarification. *Boletaceae* excluded. (Generic name, authority and date given only.)

*Auriculariaceae*:

70. *Laschia* Fries, 1830.

*Thelephoraceae*:

71. *Porogramme* Pat., 1899.  
72. *Porothelium* Fries, 1874.  
73. *Solenia* Pers. ex Fries, 1822.

*Meruliaceae*:

74. *Junghuhnina* Corda, 1842.  
75. *Aschersonia* Endlicher, 1842.  
76. *Hymenogramme* Mont. & Berk., 1844.  
77. *Laschia* Junghuhn, 1839. Not Fries, 1830.  
78. *Favolaschia* Pat., 1887.  
79. *Gyrophana* Pat., 1897.  
80. *Gyrophora* Pat., 1887.  
81. *Hologloea* Pat., 1900.  
82. *Merulius* Hall. ex Fries, 1821.  
83. *Sesia* Adans. ex O.K., 1898.  
84. *Mycodendron* Massee, 1891.  
85. *Porolaschia* Pat., 1887.  
86. *Serpula* Pers. ex S. F. Gray, 1821.  
87. *Xylophagus* Link, 1809.  
88. *Xylomyzon* Pers., 1825.

(This genus is used by some for brown spored species of *Merulius*.)

## Lists of Excluded Genera

### V. PRE-FRIESIAN GENERA MENTIONED IN THE LITERATURE

89. *Agaricon* Adans., Fam. 2: 10. 1763.
90. *Agaricus* (Dill.) L., Sp. Pl. 1176. 1753. Not *Agaricus* Fries 1821.  
Based on *A. Quercinus* L. and used by Murrill for species of *Dae-  
dalea* between 1905 and 1906 after which it was discarded.
91. *Buglossus* Wahl., Fl. Ups. 459. 1820.  
Based on *B. Quercinus*, applied to *Fistulina hepatica*.
92. *Cellularia* Bull., Herb. France 9. pl. 414. 1788. (See No. 141.)
93. *Ceratophora* Humb., Fl. Friberg. 112. 1793.  
Based on abnormal forms of *Trametes odorata*.
94. *Ceratomyces* Batarr., Fung. Hist. 62. pl. 29. f. A, B. 1755.  
Based on a *Polyporus* and several species of *Boletus*. Murrill uses  
this in the *Boletaceae*.
95. *Favolus* Pal. de Beauv., Fl. Owar. 1: 1. pl. 1. 1805. Not Fries, 1828.  
Based on *F. hirtus* Pal. de Beauv.
96. *Hexagona* Poll., Pl. Nov. 35. pl. 2-3. 1816. Not Fries. 1838.  
Based on *H. alveolaris* (DC.)
97. *Kordera* Adans., Fam. 2: 10. 1763.
98. *Leptopora* Raf., Journ. de Bot. (Desv.) 2: 177. 1809.
99. *Microporus* Pal. de Beauv., Fl. Owar. 1: 12. pl. 43. 1805.  
Based on *M. perula* Pal. de Beauv. (*P. xanthopus*).
100. *Mison* (Grae.) Adans., Fam. 2: 10. 1763.
101. *Mucilago* Hoffm., Bot. Taschenb. pl. 12. f. 2. 1795.  
Preoccupied by *Mucilago* Mich. ex Adans., 1762.  
Synonymous with *Xylophagus*.
102. *Phorima* Raf., Journ. de Bot. (Desv.) 2: 177. 1809.
103. *Poria* Brown ex Adans., Fam. 2: 10. 1763.
104. *Poria* Persoon, Neues Mag. Bot. (Roem.) 1: 109. 1794.  
Based on *P. medulla-panis* Jacq. ex Pers.
105. *Pyreium* Paul., Icon. Champ. pl. 5, f. 1-3. 1793.
106. *Scutiger* Paul., Icon. Champ. pl. 31, f. 1-3. 1793.  
Based on *S. tuberosus* Paul.
107. *Serda* Adans., Fam. 2: 11. 1763.
108. *Sesia* Adans., Fam. 2: 10. 1763.
109. *Striglia* Adans., Fam. 2: 10. 1763.
110. *Xylometron* Paul., Icon. Champ. pl. 3. f. 1-4. 1793.

### VI. NOMINA NUDA

The following two genera were published without generic diagnosis, at least in the oldest known source reference: Rev. Myc. 3(9): 17-18. 1881. In case earlier references are found one or both may become valid, or may prove to be synonyms.

111. *Caloporus* Karst., p. 18. (See also under Synonyms.)  
Based on *C. incarnatus* (A. & S.).



112. *Postia* Karst., p. 17. (See also under Homonyms.)

Based on *Polyporus borealis* Fr.

#### VII. TERATOLOGIC GENERA

The following genera were based on specimens which were obviously teratological in nature. They are thus invalidated. Some genera from List III may later be included here.

113. *Bresadolia* Speg., Fung. Guar. 1: 15. 1883.  
Based on *B. paradoxa* Speg.  
(Lloyd considered this a good genus.)
114. *Ceratomyces* Corda, in Sturm, Deutsch. Krypt. Fl. 3: 133. t. 61. 1837.  
Based on *C. Fischeri* Corda.
115. *Cladosporus* Chev., Fung. 1837.  
Based on *C. fulvus* Chev.
116. *Myriadoporus* Peck, Torr. Bot. Cl. Bull. 11: 27. 1884.  
Based on abnormal forms of *Boletus adustus* Willd.
117. *Ptychogaster* Corda, Icon. Fung. 2: 24. 1838.  
Based on imperfect stages of various polypores, especially *P. albus* Corda.

#### VIII. HOMONYMS

118. *Agaricus* (Dill. ex L.) Murrill, Torr. Bot. Cl. Bull. 32: 83. 1905.  
Preoccupied by *Agaricus* L. ex Fr. 1821.
119. *Boletopsis* P. Henn., Engl.-Pr., Nat. Pflanzenfam. 1(1)\*\*: 194. 1900.  
Preoccupied by *Boletopsis* Fayod, 1889.
120. *Boletus* Dill. ex S. F. Gray, Nat. Arr. Brit. Pl. 1: 640. 1821.  
Preoccupied by *Boletus* Dill. ex Fr., 1821.
121. *Boudiera* Lazaro, R. Acad. Cienc. Madr. Rev. 14: 835. 1915-16.  
Preoccupied by *Boudiera* Cooke, 1877.
122. *Caloporus* Quél., Ench. 164. 1886.  
Preoccupied by *Caloporus* Karst., 1881.
123. *Campbellia* Cooke & Massee, Grev. 18: 87. 1889.  
Preoccupied by *Campbellia* Wight, 1850.
124. *Cryptoporus* Shear, Torr. Bot. Cl. Bull. 29: 450. 1902.  
Preoccupied by *Cryptoporus* Hubbard, 1892.
125. *Dendrophagus* Murrill, Torr. Bot. Cl. Bull. 32: 473. 1905.  
Preoccupied by *Dendrophagus* Toumey, 1900.
126. *Enslinia* Fr., Summ. Veg. Scand. 2: 399. 1849.  
Preoccupied by *Enslinia* Rchb., 1828.
127. *Hansenia* Karst., Soc. Faun. Fl. Fenn. Medd. 5: 40. 1879.  
Preoccupied by *Hansenia* Turcz., 1844.
128. *Inoderma* Karst., Soc. Faun. Fl. Fenn. Medd. 5: 39. 1879.  
Preoccupied by *Inoderma* S. F. Gray, 1821.
129. *Merisma* Gillet, Champ. 1: 688. 1878.  
Preoccupied by *Merisma* Schw., 1822.  
*Merisma* S. F. Gray, 1821.

130. *Merisma* Torrend, Brotéria, Série Botanica **21**: 35. 1923.  
Preoccupied by *Merisma* Schw., 1822.  
*Merisma* S. F. Gray, 1821.
131. *Pelloporus* Torrend, Brotéria, Série Botanica **22**: 6. 1924.  
Preoccupied by *Pelloporus* Quélet, 1886.
132. *Polyporus* Pers. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.  
Preoccupied by *Polyporus* Mich. ex Fr., 1821.  
(Based on and including only *P. ramosus*, a form of *P. sulphureus*.)
133. *Poria* Pers. ex Karst. emend Cooke, Grev. **14**: 109. 1885.  
Preoccupied by *Poria* Pers. ex S. F. Gray.
134. *Porodiscus* Murrill, Torr. Bot. Cl. Bull. **30**: 432. 1903.  
Preoccupied by *Porodiscus* Grev., 1863.
135. *Tilotus* Kalchb., Grev. **9**: 137. 1881.  
Preoccupied by *Tylotus* J. Ag., 1876. (an orthographic variant)
112. *Postia* Karst., Rev. Myc. **3**: 17. 1881.  
Preoccupied by *Postia* Boiss. & Blanch., 1875.

## IX. GENERA CONSIDERED SYNONYMOUS

With earlier valid genera, at least until microscopic study of sufficient material shall prove a distinct difference exists.

136. *Antrodia* Karst., Soc. Faun. Fl. Fenn. Medd. **5**: 40. 1879.  
Based on *Daedalea mollis* Sommerf.  
Considered synonymous with *Trametes* Fr.
137. *Apus* Esen. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 617. 1821.  
Based on material now referred to *Lenzites* and *Schizophyllum*.
138. *Aurantioporus* Murrill, Torr. Bot. Cl. Bull. **32**: 487. 1905.  
Based on *Boletus Pilotae* Schw., placed with *Pycnoporus*.
139. *Bulliardia* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 839. 1915-16.  
Based on *Boletus unicolor* Schaeff.  
Referred to *Cerrena* Mich. ex S. F. Gray.
140. *Caloporia* Karst., Fin. Basidsv. Suppl. **2**: 23. 1893.  
Based on *Polyporus violaceus* Fr.  
Referred to *Tyromyces* Karst. on authority of Donk.
111. *Caloporus* Karst., Rev. Myc. **3**(9): 18. 1881.  
An earlier name for *Caloporia* Karst.
141. *Cellularia* Bull. ex O.K., Rev. Gen. **3**(2): 451. 1891.  
Based on *Agaricus betulinus* L.  
A synonym of *Lenzites* Fr.
142. *Ceraporia* Donk, Rev. **2**: 170. 1933.  
Based on *Poria viridans* (B. & Br.) Sacc., not at present considered distinct enough from *Podoporia* Karst. to warrant generic rank.
143. *Cerioporus* Quél., Ench. 167. 1886.  
Based on *Boletus caudicinus* Scop.  
Referred to *Polyporus* Fries.



144. *Chaetoporus* Karst., Hedw. **28**: 148. 1890.  
Based on *C. tenuis* Karst.  
Probably referable to *Poria* S. F. Gray.
145. *Cladodendron* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 863. 1915-16.  
Based on *C. frondosus* (Oeder.)  
Referred to *Grifola* S. F. Gray.
146. *Cladomeris* Quél., Ench. 167. 1886.  
Based on *C. ramosissima* (Scop.)  
Referred to *Grifola* S. F. Gray.
147. *Coltriciella* Murrill, Torr. Bot. Cl. Bull. **31**: 348. 1904.  
Based on *Polyporus dependens* B. & C.  
Not considered distinct from *Coltricia* S. F. Gray.
148. *Coriolellus* Murrill, Torr. Bot. Cl. Bull. **32**: 481. 1905.  
Based on *Trametes sepium* Berk.  
Referred to *Trametes* Fr.
149. *Cubamyces* Murrill, Torr. Bot. Cl. Bull. **32**: 480. 1905.  
Based on *Polyporus cubensis* Mont.  
Reduced to synonymy under *Trametes* Fr. by Murrill in N. Am. Fl. **9**: 43. 1907.
150. *Cyclomycetella* Murrill, Torr. Bot. Cl. Bull. **31**: 422. 1904.  
Based on *Boletus pavonius* Hook., a misinterpreted *Coriolus* species.
151. *Cycloporellus* Murrill, Torr. Bot. Cl. Bull. **34**: 468. 1907.  
Based on *Polyporus iodinus* Mont. At present not considered distinct from *Cyclomyces* Fr.
152. *Cycloporus* Murrill, Torr. Bot. Cl. Bull. **31**: 423. 1904.  
Based on *Cyclomyces Greenei* Berk. Based on habitat and not at present considered distinct from *Cyclomyces* Fr.
153. *Daedaloides* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 675. 1915-16.  
Based on *D. pinicola* Lazaro.  
This probably falls in the existing *Daedalea* complex.
154. *Elfvigia* Karst., Krit. Ofvers. Fin. Basids. 333. 1889.  
Based on *E. lipsiensis* (Batsch.), a synonym of *Fomes applanatus* (Pers.) Gill., assigned to *Ganoderma* Karst.
155. *Elmerina* Bres., Ann. Myc. **10**: 507. 1912.  
Based on *Poria setulosa* P. Henn.  
A synonym of *Elmeria* Bres.
156. *Flaviporellus* Murrill, Torr. Bot. Cl. Bull. **32**: 425. 1905.  
Based on *Polyporus Splitgerberi* Mont. which, from the description, seems to be a tropical segregate of *Laetiporus* Murrill.
157. *Friesia* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 587. 1915-16.  
Based on *F. applanata* (Pers.) Gill., assigned to *Ganoderma* Karst., and including other species belonging to *Fomes* Kickx.

158. *Fomitiporella* Murrill, N. Am. Fl. **9**: 12. 1907.  
Based on *Poria umbrinella* Bres.  
Considered synonymous with *Physisporus* Chev.
159. *Fomitopsis* Karst., Soc. Faun. Fl. Fenn. Medd. **6**: 9. 1881.  
Based on *Boletus unguulatus* Schaeff.
160. *Fuscoporella* Murrill, N. Am. Fl. **9**: 6. 1907.  
This seems insufficiently distinct from *Physisporus* Chev.  
Based on *F. coruscans* Murrill.
161. *Fuscoporia* Murrill, N. Am. Fl. **9**: 3. 1907.  
Based on *Boletus ferruginosus* Schrad., which more often than not, in some areas, exhibits the characters assigned to *Fomitiporia* Murrill.
162. *Hemidiscia* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 575. 1915-16.  
Based on *Polyporus lacteus* Fries, assigned to *Irpex*, and including other species scattered through the polypore complex.
163. *Heterobasidion* Brefeld, Unters. **8**: 154. 1889.  
Based on *Polyporus annosus* Fr.  
Assigned to *Fomes* Kickx.
164. *Heteroporus* Lazaro, R. Acad. Cienc. Madr. Rev. **15**: 119. 1916-17.  
Based on *Boletus biennis* Bull.  
Referred to *Abortiporus* Murrill.
165. *Hirschioporus* Donk, Rev. **2**: 162. 1938.  
Based on *Polyporus abietinus* (Dicks.) Fr.  
This species can be interpreted either as an *Irpex*, after Ames, or as a *Coriolus*, after Murrill.
166. *Hydnoporia* Murrill, N. Am. Fl. **9**: 3. 1907.  
Based on *Sistotrema fuscescens* Schw.  
A synonym of *Hydnochaete* Bres.
167. *Hypodrys* Pers., Myc. Eur. **2**: 148. 1825.  
Based on *Fistulina hepaticus* Huds.
168. *Inodermus* Quél., Ench. 173. 1886.  
Based on *I. hispidus* (Bull.).  
Referred to *Inonotus* Karst.
169. *Irpiciporus* Murrill, Torr. Bot. Cl. Bull. **32**: 471. 1905.  
Based on *Irpex mollis* B. & C., referred to *Irpex* Fr.  
I see no need, at present, to drop *Irpex* from the literature. It may be broken up into generic segments such as *Hydnochaete*, *Cerrenella* and *Irpex*, but not discarded entirely.
170. *Lenzitia* Karst., Fin. Basidsv. 337. 1889.  
Based on *Agaricus hirsutus* Schaeff.  
This is a synonym of *Lenzites sepiaria* Fr. upon which Karsten based *Gloeophyllum*.



171. *Leptoporus* Quél., Ench. 175. 1886.  
Based on *L. epileucus* (Fr.).  
This genus was considered synonymous with *Bjerkandera* Karst. by Murrill.
172. *Leucoporus* Quél., Ench. 165. 1886.  
Based on *L. lepidus* (Fr.), a good *Polyporus*.
173. *Lignosus* Torrend, Brotéria, Série Botanica 20: 107. 1922.  
Based on the *Lignosus* section of Lloyd's "Stipitate Polypores."  
This heterogenous group, as is true of the other Torrend genera, falls into more than one of the genera here considered valid.
174. *Melanoporella* Murrill, N. Am. Fl. 9: 14. 1907.  
Based on *Polyporus carbonacea* B. & C.  
Here considered synonymous with *Melanoporia* Murrill.
175. *Melanopus* Pat., Hym. Eur. 137. 1887.  
Based on *Boletus squamosus* Huds., the type of *Polyporus* Fr.
176. *Mensularia* Lazaro, R. Acad. Cienc. Madr. Rev. 14: 736. 1915-16.  
Based on *Boletus radiatus* Sow.  
Referred to *Inonotus* Karst.
177. *Meripilus* Karst., Bidr. Finl. Nat. o. Folk. 37: 33. 1882.  
Probably based upon *Boletus giganteus* Pers.  
Now placed in *Grifola* S. F. Gray.
178. *Microporus* Beauv. ex O.K., Rev. Gen. 3(2): 494. 1898.  
Based on *M. concinnus* Beauv.  
Synonym of *Coltricia* S. F. Gray.
179. *Microporellus* Murrill, Torr. Bot. Cl. Bull. 32: 483. 1905.  
Based on *Polyporus dealbatus* B. & C.  
Considered a good *Polyporus*.
180. *Mucronoporus* Ell. & Ev., Journ. Myc. 5: 28. 1889.  
Based on *Polyporus Balansae* Speg., placed in *Inonotus* Karst., and including other species scattered through the pore complex characterized, among other things, by the presence of setae as in *Hymenochaete*.
181. *Ochroporus* Schroet., Krypt. Fl. Schles. 3: 483. 1889.  
Based on *O. contiguus* (Pers.) (*Polyporus igniarius* L. ex Fr.)  
Placed in *Phellinus* Quél.
182. *Oglioporus* Bref., Unters. 8: 114. 1889.  
Based on *O. farinosus* Bref. which Murrill considered a good *Tyromyces*.
183. *Onnia* Karst., Fin. Basidsv. 326. 1889.  
Based on *Polyporus circinatus* Fr.  
Synonymous with *Mucronoporus* E. & E. and thus reduced to synonymy under *Inonotus*, *Phellinus* and other related genera.

184. *Ovinus* Torrend, Brotéria, Série Botancia 22: 13. 1924.  
Based on the section *Ovinus* of Lloyd's "Stipitate Polypores," and thus synonymous with *Albatrellus*, *Polyporus*, etc.
185. *Pelloporus* Quél., Ench. 166. 1886.  
Based on *Polyporus triqueter* Fr.  
A synonym of *Inonotus* Karst.
186. *Petaloides* Torrend, Brotéria, Série Botanica 21: 17. 1923.  
Based on Lloyd's section *Petaloides* of *Polyporus* and *Polystictus*.  
Referrable to lateral stemmed species of *Albatrellus*, *Polyporus*, *Favolus*, etc.
187. *Phaeolus* Pat., Ess. Taxon. 86. 1900.  
Based on *Polyporus Schweinitzii* Fr.  
Placed in *Hapalopilus* until convincing proof to the contrary can be found.
188. *Phaeoporus* Schroet., Krypt. Fl. Schles. 3: 489. 1889.  
Based on *Boletus obliquus* Pers.  
Considered by Donk a synonym of *Inonotus* Karst.
189. *Phyllodontia* Karst., Hedw. 22: 163. 1883.  
Based on *P. Magnusii* Karst.  
Best left in *Irpex* until better known.
190. *Physisporinus* Karst., Fin. Basidsv. 324. 1889.  
Based on *Poria vitrea* Pers.  
Probably best considered with *Podoporia* Karst.
191. *Placodes* Quél., Ench. 170. 1886.  
Based on *P. flabelliformis* (Scop.).  
A synonym of *Ganoderma lucida* (Leyss. ex Fr.) Karst., thus becoming synonymous with *Ganoderma* Karst.
192. *Polypilus* Karst., Rev. Myc. 3: 17. 1881.  
Based on *Boletus frondosus* Schrank.  
A synonym of *Grifola* S. F. Gray.
193. *Polyporellus* Karst., Soc. Faun. Fl. Fenn. Medd. 5: 37. 1880.  
Based on *Boletus brumalis* Pers., a good *Polyporus* species.
194. *Polystictoides* Lazaro, R. Acad. Cienc. Madr. Rev. 14: 754. 1915-16.  
Based on *Boletus cuticularis* Bull., an *Inonotus*.  
Includes several representatives of *Coriolus*, *Irpex*, etc.
195. *Polystictus* Fries, Nov. Symb. Myc. 54. 1851.  
Based on *P. perennis* Fr., the type of *Coltricia* S. F. Gray.
196. *Poronidulus* Murrill, Torr. Bot. Cl. Bull. 31: 425. 1904.  
Based on *Boletus conchifer* Schw.  
Probably best placed under *Coriolus* although Ames considered it distinct.
197. *Pseudofomes* Lazaro, R. Acad. Cienc. Madr. Rev. 14: 582. 1915-16.  
Based on *Polyporus nigricans* (Bull.) Fr., a member of the genus *Phellinus*.



198. *Pycnoporellus* Murrill, Torr. Bot. Cl. Bull. **32**: 489. 1905.  
Based on *Polyporus fibrillosus* Karst.  
More probably an *Inonotus* Karst.
199. *Romellia* Murrill, Torr. Bot. Cl. Bull. **31**: 338. 1904.  
Based on *Polyporus Schweinitzii* Fr.  
This genus was later considered synonymous with *Phaeolus* Pat.  
I place it in *Haplophilus* Karst.
200. *Pyropolyporus* Murrill, Torr. Bot. Cl. Bull. **30**: 109. 1903.  
Based on *Boletus igniarius* L., a synonym of *Phellinus*.
201. *Sarcoporia* Karst., Hedw. **33**: 15. 1894.  
Based on *S. polyspora* Karst., considered by Donk a synonym of *Podoporia* Karst.; probably both genera were based on the same material according to Donk.
202. *Scalaria* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 741. 1915-16.  
Based on *S. fusca* Lazaro.  
Probably synonymous with one of the perennial genera here considered valid.
203. *Scenidium* O.K., Rev. Gen. **3**: 515. 1893.  
Based on *Favolus hirtus* Beauv., a good *Favolus*.
204. *Scindalma* Hill ex O.K., Rev. Gen. **3**: 517. 1893.  
Based on *Boletus igniarius* L.  
A synonym of *Phellinus* Quél.
205. *Sclerodepsis* Cooke, Grev. **19**: 49. 1890-91.  
Based on *Trametes colliculosa* Berk.  
A segregate of *Trametes* Fries.
206. *Scutigera* Paul. ex Murrill, Torr. Bot. Cl. Bull. **30**: 428. 1903.  
Based on *S. tuberosus* Paul.  
Synonymous with *Albatrellus* S. F. Gray.
207. *Spongioides* Lazaro, R. Acad. Cienc. Madr. Rev. **14**: 574. 1915-16.  
Based on *Boletus cryptarum* Bolt. which may be assigned to *Poria*, or one of its segregates, as it is included in Gray's list of species in that genus.
208. *Spongiosus* Torrend, Brotéria, Série Botanica **21**: 39. 1923.  
Based on Lloyd's section *Spongiosus* of "Stipitate Polypores" and so synonymous with other valid genera.
209. *Stigmatolemma* Kalchb., Grev. **10**: 104. 1882.  
Based on *S. incanum* Kalchb.  
A synonym of *Porothelium* according to Saccardo.
210. *Striglia* Adans. ex O.K., Rev. Gen. **2**: 871. 1891.  
Synonymous with *Daedalea*.
211. *Strilia* Mich. ex S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.  
Based on *Boletus cinnamomeus* Jacq.  
Synonymous with *Coltricia* S. F. Gray.

212. *Tinctoporia* Murrill, N. Am. Fl. 9: 14. 1907.  
Based on *Poria Fuligo* B. & Br. var. *aurantiotingens* Ell. & Mac-Bride. Possibly not distinct from *Fomitiporia* unless the wood staining properties are considered generic.
213. *Trechispora* Karst., Hedw. 29: 147. 1890.  
Based on *T. onusta* Karst.  
Donk considers this a synonym of *Poria*.
214. *Underwoodina* O.K., Rev. Gen. 3(2): 538. 1898.  
Erected to replace *Aschersonia* Berk. and Mont. 1844. Not. Endl. 1842.
215. *Ungularia* Lazaro, R. Acad. Cienc. Madr. Rev. 14: 668. 1915-16.  
Based on *Boletus Betulinus* Bull.  
A synonym of *Piptoporus* Karst.
216. *Ungulina* Pat., Cat. Tun. 48. 1897.  
Based on *Polyporus ochroleucus* Berk., a questionable *Ganoderma*; and originally including a number of species assignable to most perennial genera.
217. *Xanthochrous* Pat., Cat. Tun. 51. 1897.  
Based on *Boletus perennis* L., the type of *Coltricia* S. F. Gray. Originally including a number of brown context species with and without setae placeable in most brown context annual and perennial genera.
218. *Xylodon* (Ehr.) Karst., Soc. Faun. Fl. Fenn. Acta 2: 31. 1881.  
Based on various species of *Irpex* including *I. paradoxus* Fr.
219. *Xylodon* Ehrh. ex O.K., Rev. Gen. 3(2): 540. 1898.  
Based on *X. candidus* Ehrh., a species of *Irpex* Fries.

It might be added parenthetically that the above genera are distributed through the following subfamilies of the *Aphyllphoraceae*, after Patouillard (18) and Donk (33), as follows:

*Corticioideae*: At least three sections of *Poria*, as treated at present, belong in three or more generic segregates of this heterogeneous group.

*Phylacterioideae*: *Boletopsis*.

*Polyporoideae*: All genera with light context, except those noted in this paragraph; and those with brown context except those with setae and their relatives.

*Ganodermoideae*: *Ganoderma*, *Amauroderma*.

*Hymenochaetoideae*: All those genera with brown context which have setae as in *Hymenochaete* and their close relatives in which the setae have disappeared.

*Fistulinoideae*: *Fistulina*.

## KEY TO THE GENERA OF PORE FUNGI RECOGNIZED IN LIST I

1. Tubes free from each other . . . . . 1. *Fistulina*
1. Tubes always united . . . . . 2
  2. Fructifications always resupinate (on occasion, however, a pileate condition occurs tending to show a degree of artificiality in the group), simple or stratified . . . . . 3
  2. Fructification pileate, stalked, sessile, or rarely resupinate . . . . . 8
3. Context white or light colored, not brown . . . . . 4
3. Context brown or black . . . . . 5
  4. Context white, creamy, ashy to blackish or yellowish, not becoming brighter on being bruised or in age . . . . . 2. *Poria*
  4. Context becoming pink, rose, red, purple, green, gold or some other bright color on being bruised or in age . . . . . 3. *Podoporia*
5. Hymenium strongly irpiciform or hydroid, marginal remains of tubes present only indication of relationship . . . . . 4. *Hydnochaete*
5. Hymenium strongly porose, rarely lacerate . . . . . 6
  6. Fructification black . . . . . 5. *Melanoporia*
  6. Fructification brown, pilei simple or stratoze . . . . . 7
7. Spores hyaline . . . . . 6. *Fomitiporia*
7. Spores brown . . . . . 7. *Physisporus*
  8. Spores truncate, the endospore variously marked with configurations which penetrate the epispore the outer wall of which is smooth. Pileus and stipe sometimes laccate . . . . . 8. *Ganoderma*
  8. Spores not formed as above . . . . . 9
9. Volva-like structure present . . . . . 9. *Cryptoporus*
9. Volva-like structure absent . . . . . 10
  10. Hymenophore strictly porose . . . . . 11
  10. Hymenophore variously modified, rarely, if ever, strictly porose . . . . . 40
11. Trama pale colored to wood-brown or rose, not brown . . . . . 12
11. Trama brown . . . . . 33
  12. Hymenophore stratoze, "perennial" . . . . . 13
  12. Hymenophore not stratoze, "annual" . . . . . 14
13. Hymenium with cystidia . . . . . 10. *Oxyporus*
13. Hymenium without cystidia . . . . . 11. *Fomes*
  14. Pileus stalked . . . . . 15
  14. Pileus sessile to effused-reflexed, rarely resupinate . . . . . 22
15. Pileus fleshy, spores strongly warted, becoming brown . . . . . 12. *Boletopsis*
15. Pileus fleshy or tough, spores smooth, hyaline . . . . . 16
  16. Pilei from a compound stem structure . . . . . 13. *Grifola*
  16. Pileus simple . . . . . 17
17. Pores favoloid, regular . . . . . 14. *Favolus*
17. Pores rounded or irregularly polygonal . . . . . 18
  18. Context duplex . . . . . 15. *Abortiporus*
  18. Context homogenous . . . . . 19
19. Context fleshy, pilei terrestrial . . . . . 16. *Albatrellus*
19. Context tough, pilei on wood . . . . . 20
  20. Pilei small, dependent from lenticels . . . . . 17. *Porodisculus*
  20. Pilei large, not dependent . . . . . 21
21. Stipe lateral, under surface of pileus with a broad sterile margin . . . . . 18. *Piptoporus*
21. Stipe lateral or central, pileus without a broad sterile margin . . . . . 19. *Polyporus*
  22. Trama some tint of yellow, orange or red . . . . . 23
  22. Trama white to wood-colored . . . . . 25
23. Hymenial surface, and sometimes the context, sulphur yellow . . . . . 20. *Laelioporus*
23. Color darker . . . . . 24
  24. Tubes several mm. in diameter and more than 1 cm. long . . . . . 21. *Aurantio-porellus*
  24. Tubes usually less than 1 mm. in diameter and less than 1 cm. long . . . . . 22. *Pycnoporus*
25. Trama of pileus and tubes confluent . . . . . 23. *Trametes*
25. Trama of pileus and tubes more or less distinct . . . . . 26



26. Hymenophore arising from a distinct layer. . . . . 27  
 26. Hymenophore not distinct from the sporophore. . . . . 28  
 27. Hymenophore gelatinous, peeling away from the sporophore as a fine skin when fresh or moistened. . . . . 24. *Gloeoporus*  
 27. Hymenophore dry, not peeling away from the sporophore. . . . . 25. *Bjerkandera*  
 28. Pileus thin. . . . . 29  
 28. Pileus thick. . . . . 30  
 29. Tubes soon becoming irpiciform or lacerate. . . . . 26. *Irpex*  
 29. Tubes remaining entire. . . . . 27. *Coriolus*  
 30. Pileus fleshy when young, becoming woody in age. . . . . 28. *Ischnoderma*  
 30. Pileus tough throughout life. . . . . 31  
 31. Trama homogenous. . . . . 29. *Tyromyces*  
 31. Trama not homogenous. . . . . 32  
 32. Tubes remaining entire. . . . . 30. *Spongipellis*  
 32. Tubes becoming lacerate. . . . . 31. *Spongiporus*  
 33. Hymenium becoming irpiciform. . . . . 32. *Cerrenella*  
 33. Hymenium remaining porose or at most becoming lacerate. . . . . 34  
 34. Pilei stratose, "perennial". . . . . 35  
 34. Pilei not stratose, "annual". . . . . 36  
 35. Pilei produced singly. . . . . 33. *Phellinus*  
 35. Large numbers of pilei produced massed together on a stroma. . . . . 34. *Globifomes*  
 36. Context duplex. . . . . 37  
 36. Context homogeneous. . . . . 38  
 37. Upper layer of context formed into stiff upright groups of bristles, fructification resembling an inverted *Hydnum*. . . . . 35. *Pogonomyces*  
 37. Duplex nature not so displayed. . . . . 36. *Funalia*  
 38. Pilei very thin, usually central-stemmed. . . . . 37. *Coltricia*  
 38. Pilei thick, with or without a central stem. . . . . 39  
 39. Spores hyaline. . . . . 38. *Hapalopilus*  
 39. Spores brown. . . . . 39. *Inonotus*  
 40. Hymenophore perennial, not stratose. . . . . 40. *Porodaedalea*  
 40. Hymenophore annual, not stratose. . . . . 41  
 41. Pore walls breaking down to form concentric lamellae. . . . . 41. *Cyclomyces*  
 41. Pore walls breaking down to form radiating lamellae of labyrinthiform passages. . . . . 42  
 42. Context brown. . . . . 42. *Gloeophyllum*  
 42. Context light colored. . . . . 43  
 43. Hymenium lamellose, lamellae narrow. . . . . 43. *Lenzites*  
 43. Hymenium daedaleoid, if lamellose the lamellae are broad. . . . . 44  
 44. Labyrinthiform tubes large, walls very thick. . . . . 44. *Daedalea*  
 44. Labyrinthiform tubes small, walls thin. . . . . 45  
 45. Hymenium soon becoming irpiciform, upper surface usually pubescent. . . . . 45. *Cerrena*  
 45. Hymenium may become lacerate in age, upper surface of pileus glabrous or encrusted. . . . . 46. *Daedaleopsis*

## BIBLIOGRAPHY

(In chronological order)

1. 1821. FRIES, E. M. *Systema Mycologicum*. I. Gryphiswaldiae.
2. 1821. GRAY, S. F. *A Natural Arrangement of British Plants*. Vol. 1. London. P. 595 et seq.
3. 1828. FRIES, E. M. *Elenchus Fungorum*. Gryphiswaldiae.
4. 1830. FRIES, E. M. *Description generum et specierum*. Linnaea 5: 512.
5. 1851. FRIES, E. M. *Novae Symbolae Mycologicae*. Upsaliae. P. 54.
6. 1874. FRIES, E. M. *Hymenomycetes Europaei*. Upsaliae. P. 492 et seq.
7. 1878. GILLET, C. C. *Les Champignons*. Paris.
8. 1880. KARSTEN, P. A. *Symbolae ad Mycologicam fennicam* VI. Meddelanden af Societas pro Fauna et Flora Fennica. 1880: 5.

9. 1881. KARSTEN, P. A. Enumeratio Boletinearum et Polyporum Fennicarum, Systemate novo dispositarum. *Revue Mycologique* **3**: 16-23.
10. 1884-5. COOKE, M. C. Praecursores ad Monographiam Polyporum. *Grevillea* **13**: 80; **13** 114; **14**: 17; **14**: 77; **14**: 109.
11. 1884. WINTER, G. in Rabenhorst's Kryptogamen-Flora. 2nd. ed. **1**: 385-480.
12. 1886. QUÉLET, L. *Enchiridion Fungorum*. Lutetiae.
13. 1887. PATOUILLARD, N. *Les Hyménomycètes d'Europe*. Paris.
14. 1888. SACCARDO, P. A. *Sylloge Fungorum*, Vol. 6.
15. 1889. SCHROETER, J. in Cohn's Kryptogamen-Flora von Schlesien. **3**: 464 et seq. Breslau.
16. 1891-1898. KUNTZE, OTTO. *Revisio generum plantarum*. Pars II. Fungi P. 840-875; Pars III, 2. Fungi P. 438-544.
17. 1898-1925. LLOYD, C. G. *Mycological Writings*. Cincinnati. Vol. 1-7.
18. 1900. PATOUILLARD, N. *Essai Taxonomique sur les familles et les genres des Hyménomycètes*. Lons-le-Saunier.
19. 1903. MURRILL, W. A. A new family of the Basidiomycetes. *Torreyia* **3**: 7.
20. 1903. MURRILL, W. A. A historical review of the genera of the Polyporaceae. *Journal of Mycology* **9**: 87-102.
21. 1907. MURRILL, W. A. Polyporaceae. *North American Flora* **9**: 1 et seq.
22. 1913. AMES, ADELINE. A consideration of structure in relation to genera of the Polyporaceae. *Annales Mycologici* **11**: 211 et seq.
23. 1914. NEUMAN, J. J. The Polyporaceae of Wisconsin. *Wisconsin Geological and Natural History Survey Bulletin* **33**.
24. 1914. OVERHOLTS, L. O. The Polyporaceae of Ohio. *Missouri Botanical Garden Annals* **1**: 81-155.
25. 1915-16. LAZARO Y IBIZA, BLAS. Los Polyporeos de la Flora española. *Revista de la Real Academia de Ciencias exactas, fisicias y naturales* **14**: 427-464; 488-524; 574-592; **15**: 87-120.
26. 1920. TORREND, C. Les Polyporacées de Brésil. *Polyporacées Stipitées*. *Brotéria, Série Botánica*, **18**: 121-143.
27. 1922. REA, C. *British Basidiomycetes*. Cambridge. P. 574 et seq.
28. 1925. TROTTER, A. In Saccardo's *Sylloge Fungorum* Vol. 23.
29. 1927. CUNNINGHAM, G. H. The Polyporaceae of New Zealand. *Transactions of the New Zealand Institute* **58**: 202-250.
30. 1928. BOURDOT, L'ABBÉ H., et A. GALZIN. I. *Hyménomycètes de France*. Paris.
31. 1928. KILLERMANN, S. In Engler and Prantl's *Die Natürlichen Pflanzenfamilien*. 2nd. ed. **6**: 169 et seq.
32. 1931. SHOPE, P. F. The Polyporaceae of Colorado. *Missouri Botanical Garden Annals* **18**: 287-456.
33. 1933. DONK, M. A. Revision der Niederländischen Homobasidiomycetae-Aphyllporaceae II. *Bot. Mus. Herb. Univ. Utrecht Med. No. 9*.
34. 1933. OVERHOLTS, L. O. The Polyporaceae of Pennsylvania. The Genus *Polyporus*. *Pennsylvania State College Technical Bulletin*. Bulletin **298**.
35. 1934. LOWE, J. The Polyporaceae of New York State. *Bulletin of the New York State College of Forestry* Vol. 6. No. 1-b. Technical Publication No. **41**.
36. 1935. BRIQUET, J. *International Rules of Botanical Nomenclature*. Gustav Fischer. Jena. P. 123.
37. 1939. HILBORN, M. T. and D. H. LINDER. The synonymy of *Fomes fomentarius*. *Mycologia* **31**: 418.
38. 1939. GRAFF, P. W. North American Polypores—II. *Polyporus biennis* and its varieties. *Mycologia* **31**: 466-484.

## ALPHABETICAL INDEX TO GENERA

Numbers refer to position in first 9 lists. Genera in List I are referred to here in capital letters.

ABORTIPORUS Murrill.....	1	Dendrophagus Murrill.....	125
Agaricon Adans.....	89	Dictyopanus Pat.....	49
Agaricus Dill. ex L.....	90		
Agaricus (Dill.) L. ex Murrill.....	118	Earliella Murrill.....	50
ALBATRELLUS Mich. ex S. F. Gray.....	2	Elfvingia Karst.....	154
Amauroderma Murrill.....	47	Elmeria Bres.....	51
Antrodia Karst.....	136	Elmerina Bres.....	155
Apus Esen. ex S. F. Gray.....	137	Enslinia Fries.....	126
Aschersonia Endl.....	75		
AURANTIPORELLUS Murrill.....	3	Favolaschia Pat.....	78
Aurantiorporus Murrill.....	138	FAVOLUS Fries.....	14
		Favolus Pal. de Beauv.....	95
BJERKANDERA Karst.....	4	FISTULINA Bull. ex Fries.....	15
BOLETOPSIS Fayod.....	5	Flaviporellus Murrill.....	156
Boletopsis P. Henn.....	119	Flaviporus Murrill.....	52
Boletus Dill. ex S. F. Gray.....	120	FOMES Kickx.....	16
Boudiera Lazaro.....	121	Fomitella Murrill.....	53
Bresadolia Speg.....	113	Fomitiporella Murrill.....	158
Buglossus Wahl.....	91	FOMITIPORIA Murrill.....	17
Bulliardia Lazaro.....	139	Fomitopsis Karst.....	159
		Friesia Lazaro.....	157
Caloporia Karst.....	140	FUNALIA Pat.....	18
Caloporus Quélet.....	122	Fuscoporella Murrill.....	160
Caloporus Karst.....	111	Fuscoporia Murrill.....	161
Campbellia Cooke & Massee.....	123		
Cellularia Bull.....	92	GANODERMA Karst.....	19
Cellularia Bull. ex O.K.....	141	GLOBIFOMES Murrill.....	20
Ceraporia Donk.....	142	GLOEOPHYLLUM Karst.....	21
Ceratophora Humb.....	93	GLOEOPORUS Mont.....	22
Ceriumyces Batarr.....	94	GRIFOLA Mich. ex S. F. Gray.....	23
Ceriumyces Corda.....	114	Gryophana Pat.....	79
Ceriporus Quélet.....	143	Gyrophora Pat.....	80
CERRENA Mich. ex S. F. Gray.....	6		
CERRENELLA Murrill.....	7	Hansenia Karst.....	127
Chaetoporus Karst.....	144	HAPALOPILUS Karst.....	24
Cladodendron Lazaro.....	145	Hemidiscia Lazaro.....	162
Cladomeris Quélet.....	146	Henningsia Moeller.....	66
Cladosporus Chev.....	115	Heterobasidion Bref.....	163
COLTRICIA Mich. ex S. F. Gray.....	8	Heteroporus Lazaro.....	164
Coltriciella Murrill.....	147	Hexagona Fries.....	54
Coriollus Murrill.....	148	Hexagona Poll.....	96
Coriolopsis Murrill.....	48	Hirschioporus Donk.....	165
CORIOLUS Quélet.....	9	Hologloea Pat.....	81
CRYPTOPORUS Hubbard.....	10	HYDNOCHAETE Bres.....	25
Cryptoporus Shear.....	124	Hydnoporia Murrill.....	166
Cubamyces Murrill.....	149	Hymenogramme Berk. & Mont.....	76
CYCLOMYCES Fries.....	11	Hypodrys Pers.....	167
Cyclomycetella Murrill.....	150		
Cycloporellus Murrill.....	151	Inoderma Karst.....	128
Cycloporus Murrill.....	152	Inodermus Quélet.....	168
		INONOTUS Karst.....	26
DAEDALEA Pers. ex Fries.....	12	IRPEX Fries.....	27
Daedaloides Lazaro.....	153	Irpiciporus Murrill.....	169
DAEDALEOPSIS Schroet.....	13	ISCHNODERMA Karst.....	28



Junghuhnia Corda.....	74	Polypilus Karst.....	192
Kordera Adans.....	97	Polyporellus Karst.....	193
Laccocephalum McAlp. & Tepp.....	55	POLYPORUS Mich. ex Fries.....	38
LAETIPORUS Murrill.....	29	Polyporus Pers. ex S. F. Gray.....	132
Laschia Fries.....	70	Polystictoides Lazaro.....	194
Laschia Jungh.....	77	Polystictus Fries.....	195
LENZITES Fries.....	30	PORIA Pers. ex S. F. Gray.....	39
Lenzitina Karst.....	170	Poria Brown ex Adans.....	103
Leptopora Raf.....	98	Poria Pers.....	104
Leptoporus Quélet.....	171	Poria Pers. ex Karst. emend. Cooke.....	133
Leucoporus Quélet.....	172	PORODAEDALEA Murrill.....	40
Lignosus Torrend.....	173	PORODISCULUS Murrill.....	41
Melanoporella Murrill.....	174	Porodiscus Murrill.....	134
MELANOPORIA Murrill.....	31	Porogramme Pat.....	71
Melanopus Pat.....	175	Porolaschia Pat.....	85
Mensularia Lazaro.....	176	Poronidulus Murrill.....	196
Meripilus Karst.....	177	Poroptyche Beck.....	68
Merisma Gillet.....	129	Porothelium Fries.....	72
Merisma Torrend.....	130	Postia Karst.....	112
Merulius Hall. ex Fries.....	82	Pseudofavolus Pat.....	59
Microporellus Murrill.....	179	Pseudofomes Lazaro.....	197
Microporus Pal. de Beauv.....	99	Ptychogaster Corda.....	117
Microporus Beauv. ex O.K.....	178	Pycnoporellus Murrill.....	198
Mison (Grae.) Adans.....	100	PYCNOPORUS Karst.....	42
Mucilago Hoffm.....	101	Pyreium Paul.....	105
Mucronoporus E. & E.....	180	Pyropolyporus Murrill.....	200
Mycodendron Massee.....	84	Rigidiporus Murrill.....	60
Myriadoporus Peck.....	116	Rodwaya H. & P. Sydow.....	61
Nigrofores Murrill.....	56	Romellia Murrill.....	199
Nigroporus Murrill.....	57	Sarcoporia Karst.....	201
Ochroporus Schroet.....	181	Scalaria Lazaro.....	202
Oglioporus Bref.....	182	Scenidium O.K.....	203
Onnia Karst.....	183	Scindalma Hill. ex O.K.....	204
Ovinus Torrend.....	184	Sclerodepsis Cooke.....	205
OXYPORUS Donk.....	32	Scutiger Paul.....	106
Pelloporus Quélet.....	185	Scutiger Paul. ex Murrill.....	206
Pelloporus Torrend.....	131	Serda Adans.....	107
Petaloides Torrend.....	186	Serpula Pers. ex S. F. Gray.....	86
Phaeolopsis Murrill.....	58	Sesia Adans.....	83
Phaeolus Pat.....	187	Solenia Pers. ex Fries.....	73
Phaeoporus Schroet.....	188	Spongioides Lazaro.....	207
PHELLINUS Quélet.....	33	Spongiosus Torrend.....	208
Phorima Raf.....	102	SPONGIPELLIS Pat.....	43
Phyllodontia Karst.....	189	SPONGIPORUS Murrill.....	44
Phylloporus Quélet.....	67	Stigmatolemma Kalchb.....	209
Physisporinus Karst.....	190	Striglia Adans.....	109
PHYSISPORUS Chev.....	34	Striglia Adans. ex O.K.....	210
PIPTOPORUS Karst.....	35	Strilia Mich. ex S. F. Gray.....	211
Placodes Quélet.....	191	Theleporus Fries.....	69
PODOPORIA Karst.....	36	Tilotus Kalchb.....	135
POGONOMYCES Murrill.....	37	Tinctoporia Murrill.....	212
		Tomentifolium Murrill.....	62
		Tomophagus Murrill.....	63

TRAMETES Fries.....	45	Whitfordia Murrill.....	65
Trechispora Karst.....	213	Xanthochrous Pat.....	217
Trichaptum Murrill.....	64	Xylodon Ehr. ex Karst.....	218
TYROMYCES Karst.....	46	Xylodon Ehr. ex O.K.....	219
Underwoodina O.K.....	214	Xylometron Paul.....	110
Ungularia Lazaro.....	215	Xylomyzon Pers.....	88
Ungulina Pat.....	216	Xylophagus Link.....	87

## Notes on the Dacrymycetaceae

TRAVIS W. BRASFIELD  
(Perkinston, Mississippi)

DACRYMYCES CUPULARIS Lloyd, Myc. Writ. 7: 1225, pl. 255, f. 2524. 1923.

Figs. 1-5

Lloyd's description is as follows: "Sessile, 3-4 mm. in diameter, concave, cup shape. Color, pale yellow with a slight greenish tint. Basidia, forked. Spores, not found. The specimen is evidently immature as no spores were found. Most *Dacryomyces* are cushion shape, no others we know concave when soaked. There is a species in Sweden, *Dacryomyces chrysocomus*, that dries with a depressed disc, but that soaks out cushion shape and is deep orange-yellow." Lloyd's specimen was from L. Rodway, Tasmania.

The following description is based on three collections made by Dr. J. B. Cleland in Tasmania:

Clear yellow to chrome yellow throughout when fresh (Cleland), drying reddish brown, sometimes darker toward the base; up to 5 mm. in height, at first pustulate, then dimidiate, with a flat, pistonlike top which later becomes concave, contracted below into a stipelike base, the upper part of the sporophore sometimes at length cerebriform; firm gelatinous; hymenium smooth, becoming rugulose, covering the entire pileus; basidia up to  $50 \times 3.5\mu$ , including epibasidia; internal hyphae smooth to distinctly roughened,  $2.5-3.5\mu$  in diameter; no clamp connections observed; spores short-cylindrical, slightly curved,  $8.5-11 \times 3.5-4.5\mu$ , distinctly apiculate, at first simple, becoming 1-septate; conidia spherical, up to  $1.5\mu$  in diameter.

TASMANIA: Port Arthur, Jan. 20, 1928; Brown's Bridge, Jan. 29, 30, 1929, all three collections by J. B. Cleland.

Lloyd's excellent photographs and the locality in which these specimens were collected leave little doubt that this is Lloyd's species.

### *Dacrymyces gangliformis* sp. nov.

Figs. 6-10

Gregarius, primo pulvinatus, gelatinosus, 0.5 mm. diam., tandem anastomosus, effusus, resupinatus, crystallis inclusis, brunneo-ochraceus, siccus quasi invisibilis; hyphis glabris, nodoso-septatis, paraphysibus tenuibus, furcatis; basidiosporis cylindraceo-curvulis, tarde 1-septatis,  $12-14 \times 4-6\mu$ ; conidiis ovatis,  $3.4 \times 1.7\mu$ .

Dull brownish yellow when soaked, drying to an almost imperceptible, striate brownish film; at first pulvinate, then flattened discoid, finally anastomosing to form an almost resupinate film; individual tubercles up to 0.5 mm. in diameter, the anastomosing group up to 1 cm. in diameter; each tubercle attached by a slender basal portion, this not so apparent when coalesced; soft gelatinous when very wet, with scattered dull whitish



spots composed of spherical to irregular crystalloid material, crystals under the lens brownish yellow,  $6-11\mu$  in diameter; internal hyphae smooth,  $1.5\mu$  in diameter, with frequent clamp connections; paraphyses long, slender, up to  $68 \times 2\mu$ , with divergent tips; basidia (total) up to  $40 \times 4.2\mu$ ; spores cylindrical, slightly curved,  $12-14 \times 4-6\mu$ ; at first simple, tardily 1-septate, with an oil drop in each cell; conidia elongate ovoid, up to  $3.4 \times 1.7\mu$ .

MASSACHUSETTS: Canton, on rotten wood of *Pinus Strobus*, Nov. 7, 1932, D. H. Linder (R. M. Whelden 142), Type.

ARRHYTIDIA ENATA (B. & C.) Coker, Jour. Elisha Mitchell Soc. **43**: 237. 1928.

Several collections from Massachusetts extend the known range for this species, which seems not so rare as formerly supposed.

MASSACHUSETTS: Canton, April 3, 1932, on oak, D. H. Linder; April 2, 1932, on *Alnus incana*, D. H. Linder; Sept. 17, 1932, on *Alnus*, D. H. Linder and R. M. Whelden 95; Sept. 24, 1934, on *Alnus*, D. H. Linder (R. M. Whelden 6); Norwood, Purgatory Swamp, on *Pinus Strobus*, D. H. Linder.

DACRYOMITRA NUDA (Berk. & Br.) Pat. Tax. Hymen. 31. 1900.

MISSISSIPPI: Perkinston, May 20, 1939, T. W. Brasfield 530; May 29, T. W. Brasfield.

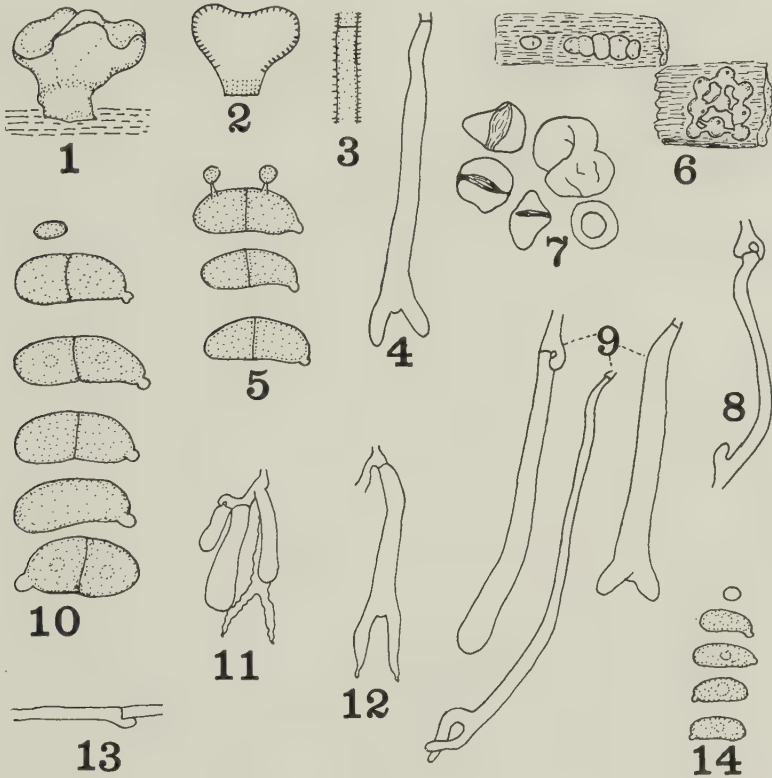
Up to 12 mm. in height and 15 mm. in breadth at the top; pileus firm gelatinous; stipe tough, averaging about 2 mm. in diameter, rarely up to 5 mm. in diameter and about one-half the total height; pileus pale amber (when not exposed to the light) to decided orange when exposed, fading to reddish orange when older and dingy reddish brown when dry, globoid, smooth when young, with crimped lower surface when older, then distinctly morcheloid and cerebriform; stipe smooth or with a few obtuse protuberances, usually subtending one pileus, but occasionally furcate and bearing several pilei; internal hyphae smooth.  $1.5-2\mu$  in diameter, without clamp connections; basidia  $40-50 \times 3-4\mu$  (total); spores cylindrical, slightly curved,  $11-15 \times 4-4.5\mu$ , simple at first, tardily 1-3 septate; conidia egg-shaped, up to  $3 \times 1.5\mu$ .

Abundant material permits a fuller description of this species. Thousands of sporophores were found in a very limited area, and are available for distribution or exchange.

CERACEA CRUSTULINA Bourd. & Galz. Bull. Soc. Myc. Fr. **39**: 266. 1923.

Figs. 11-14

Tawny olive, fading to pallid on the margin when fresh (Martin), drying grayish brown; broadly effused, corticioid, up to  $7 \times 3$  cm. in extent, indeterminate; texture firm waxy to tough throughout, easily separated from the wood; hymenium smooth or roughened, with scattered distinct fertile papillae; internal hyphae smooth,  $2.5\mu$  in diameter, with frequent



FIGS. 1-14. Microscopic details drawn with the aid of camera lucida; all figures reproduced at approximately the magnifications indicated.

*Dacrymyces cupularis* Lloyd.—1. Habit,  $\times 5\frac{1}{2}$ .—2. Longitudinal section, diagrammatic,  $\times 5\frac{1}{2}$ .—3. Internal hypha,  $\times 1388$ .—4. Basidium,  $\times 896$ .—5. Three spores, one with attached conidia,  $\times 1388$ .

*Dacrymyces gangliiformis* sp. nos.—6. Habit,  $\times 5\frac{1}{2}$ .—7. Five crystals from near edge of basidiocarp,  $\times 1000$ .—8. Internal hypha, showing characteristic clamp connection,  $\times 1388$ .—9. Two basidia and a basidium-like paraphysis,  $\times 1000$ .—10. Five spores and a conidium,  $\times 1000$ .

*Ceracea crustulina* Bourd. and Galz.—11. Group of proliferating basidia,  $\times 1000$ .—12. Single mature basidium,  $\times 1000$ .—13. Portion of internal hypha, with clamp connection,  $\times 1000$ .—14. Four spores and a conidium,  $\times 1000$ .

and conspicuous clamp connections; probasidia up to  $30 \times 3.5\mu$ , often proliferating, epibasidia up to  $9 \times 2.5\mu$ ; spores short cylindrical, slightly curved,  $7.5-10 (-11) \times 3-4\mu$ , aseptate; conidia spherical, up to  $3\mu$  in diameter.

IOWA: Iowa City, on rotten oak, G. W. Martin 4673.

So far as I am aware, this is the first report of this species from North America. *Ceracea* is apparently a good genus, but in my opinion should be restricted to the thin, resupinate, indeterminate, easily separable forms

which show no evidence of distinct rooting portions. If this be acceptable, then it is proposed that *Ceracea Lagerheimii* Pat. (Bull. Soc. Myc. Fr. 9: 141. 1893) be considered as the type species inasmuch as Cragin's type, *C. vernicosa*, has apparently been lost.

CALOCERA CORNEA var. MINIMA Coker, Jour. Elisha Mitchell Soc.

35: 182, pl. 65, f. 1, 2. 1920.

MASSACHUSETTS: Waverly Oaks, Aug. 8, 1932, on oak? R. M. Whelden 58.

This variety seems worthy of recognition. It has been known heretofore only from Coker's North Carolina collection, on pine.

DACRYMYCES ABIETINUS (Pers.) Schroet. Krypt. Fl. Schles. 3: 400. 1888.

MASSACHUSETTS: Canton, April 30, 1932, on dead limbs of cedar, D. H. Linder.

MAINE: Gorham, Aug. 29, 1934, on *Pinus Strobus*, R. M. Whelden.

Apparently common on coniferous wood, but easily overlooked due to its small size and inconspicuous appearance.

DACRYMYCES PUNCTIFORMIS Neuhoﬀ, Ark. f. Bot. 28A (1): 45. 1936.

MASSACHUSETTS: Canton, Sept. 17, 1932, on oak?, R. M. Whelden (107) and D. H. Linder; Oct. 17, 1932, on *Pinus Strobus*, D. H. Linder (R. M. Whelden 142).

Not heretofore recognized from the eastern United States

DACRYOMITRA BRUNNEA Martin, Mycologia 26:263. 1934.

NOVA SCOTIA: Sept. 12, 1935, Coll. P. A. Vestal, Comm. D. H. Linder, Farlow Herb.

MASSACHUSETTS: Canton, Aug., on maple? D. H. Linder.

A notable extension of the known range of this easily recognized species, heretofore known only from the type collection, Ontario.

DACRYOMITRA CERACEA (Coker) Brasfield, Am. Midl. Nat. 20: 224, pl. 3, figs. 51-54. 1938.

MASSACHUSETTS: Canton, July 30, 1932, on red maple limbs, D. H. Linder.

Known previously from North Carolina and Iowa.

DACRYOMITRA GLOSSOIDES Bref. Unters. 7: 162. 1888.

COSTA RICA: Santo Domingo del Roble, Prov. Heredia, Aug. 13, 1936, C. W. Dodge and V. F. Goerger 10635.

GUEPINIOPSIS TORTUS (Fr.) Pat. Tab. Fung. 28. 1883.

COLORADO: July, 1934, on juniper? Coll. P. A. Vestal, Comm. Farlow Herb.

MASSACHUSETTS: Canton, Sept. 17, 1932, on *Pinus Strobus*, R. M. Whelden 92; Sept. 24, 1934, on *Pinus Strobus*, D. H. Linder; Billerica, Nov., 1899, Coll. J. Rorer, (R. Thaxter 527, as *Guepinia merulina*), Comm. Farlow Herb.

VERMONT: Brandon, May 30, 1913, C. W. Dodge.

I wish to express my appreciation to Professor G. W. Martin for critical and timely suggestions and to Doctors D. H. Linder, R. M. Whelden, C. W. Dodge and J. B. Cleland for collections on which these notes are based.



## Melanesian Vascular Plants

F. RAYMOND FOSBERG

(U. S. Dept. of Agriculture, Washington, D. C.)

Casual collecting of plants by several members of the Templeton Crocker Expedition of 1933 in Melanesia yielded a small but interesting collection of vascular plants. The collection totals 68 specimens, representing 60 species and varieties, 9 of the species being new. All of the vascular plants were collected in the Solomon and Santa Cruz Islands.

Most of the plant collecting was done by the late Mr. Norton Stewart, whom I had asked, before the expedition started, to bring back any plants that he happened to notice. Some collecting was also done by Mr. Templeton Crocker and by Dr. John Hynes. Although locality data were supplied for all specimens, little information is available concerning altitude, habitat, or distance from the coast. It is probable that most of the specimens are from near the coast, in the vicinity of the anchorages, judging by the species obtained and from information contributed by Mr. Crocker.

The collection was submitted to me for determination by Miss Marie Neal, at the Bishop Museum, in 1935, at which time the preliminary work was done, and most of the species at least tentatively identified. In 1937 all doubtful ones were brought to Philadelphia, and studied further in the herbaria of the University of Pennsylvania, the Academy of Natural Sciences, and the New York Botanical Garden. My appreciation is here extended to the authorities of these three institutions for the use of their herbaria and libraries in this work. The specimens cited are all deposited in the herbarium of the B. P. Bishop Museum, in Honolulu. Several specimens proved unidentifiable.

Specimens were collected by the expedition at the following localities: Santa Cruz Islands: Vanikoro, Tevia Bay; Lomlom (Swallow Group), Mohawk Bay; Solomon Islands: Malaita, Uras Cove; Malaita, Tia Bay; Guadalcanal, Kau Kau Bay; San Cristobal, Star Harbour; Rennell Island; Bellona Island. Of particular interest are the specimens from the botanically unknown Rennell and Bellona Islands. It is a matter of regret that a full-time botanist did not accompany the party, to take full advantage of the days spent on these islands, from which no plants have, to my knowledge, been collected before.

That nine new species were found in such a small collection from lowland areas is, of course, a surprise, but merely shows what a botanical *terra incognita* the Solomon Islands still remain.

The algae collected by the expedition were reported on by Dr. W. A. Setchell (Proc. Calif. Acad. Sci. IV, 21: 259-276, 1935), from which report the two marine spermatophytes mentioned in this paper are quoted. I did not see these two specimens, but included them to make the report on the

vascular plants as complete as possible. Dr. Gordon Macgregor has published a short summary of the anthropological work done by the expedition (B. P. Bishop Mus. Bull. 124: 38-43, 1934), which seems to be the only general account published of the itinerary of the expedition.

I wish to thank Drs. Wm. Trelease, T. G. Yuncker, V. S. Summerhayes, and Louis O. Williams for their help with certain difficult groups, which are credited to them in their places in the paper.

## POLYPODIACEAE

1. *Nephrolepis hirsutula* (Forst.) Presl.—Rennell Island, June 20, 1933, Hynes.
2. *Campium Quoyanum* (Gaud.) Copel.—Malaita Island, Uras Cove, June 29, 1933, Stewart. This specimen might have been referred to *C. lonchophorum* (Kunze) Copel. equally well. Since these two species do not seem sufficiently distinct to be maintained separately the older name is used here.
3. A sterile fern.—Rennell Island, June 20, 1933, Hynes.

## SCHIZAEACEAE

4. *Lygodium circinnatum* Sw.—Guadalcanal Island, Kau Kau Bay, May 20, 1933, Stewart.
5. *Lygodium reticulatum* Schkuhr.—Malaita Island, Tai Lagoon, May 30, 1933, Stewart.

## LYCOPODIACEAE

6. *Lycopodium carinatum* Desv.—Vanikoro Island, Tevia Bay, on trees, May 6, 1933, Stewart.
7. *Lycopodium Phlegmaria* L.—Malaita Island, Uras Cove, May 29, 1933, Stewart.
8. *Lycopodium Phlegmaria* L. var. *mirabile* (Willd.) Fosberg, comb. nov.

*Lycopodium mirabile* Willd. Sp. Pl. 5: 11, 1810.

Vanikoro Island, Tevia Bay, on trees, May 6, 1933, Stewart.

If *L. Phlegmaria* is accepted in a rather broad sense this form of it is not sufficiently distinct to deserve specific rank. Apparently, this combination has not been made previously.

## NAJADACEAE

9. *Cymodocea ciliata* (Förssk.) Ehrb.—Malaita Island, Uras Cove, Tai Lagoon. (See Setchell, Proc. Cal. Acad. Sci. IV, 21: 269, 1935.)

## HYDROCHARITACEAE

10. *Thalassia Hemprichii* (Ehrenb.) Aschers.—Bellona Island. (See Setchell, loc. cit.)

## GRAMINEAE

11. *Centotheca latifolia* (Osbeck) Trin.—Rennell Island, June 20, 1933, Crocker.

## CYPERACEAE

12. *Cyperus Kyllingia* Endl.—Rennell Island, June 20, 1933, Crocker.  
13. *Scleria scrobiculata* Nees and Meyen.—Swallow Group, Mohawk Bay, July 6, 1933, Stewart.

## ZINGIBERACEAE

14. Sterile branch with leaves.—Rennell Island, June 20, 1933, Hynes.

## ORCHIDACEAE\*

15. *Agrostophyllum* sp.—Malaita Island, Uras Cove, May 29, 1933, Stewart. The single old flower which I have seen is not good enough for positive identification of the species. The flower looks much like those of *A. Hasseltii* (Blume) J. J. Smith and the vegetative structure compares favorably with that species.  
16. *Corymborchis veratrifolia* Blume.—Rennell Island, June 20, 1933, Crocker. Widely distributed in the eastern tropics.  
17. *Dendrobium ceratostyloides* J. J. Smith.—Malaita Island, Uras Cove, May 28, 1933, Stewart. This species has not been reported previously from the Solomon Islands so far as I am aware. The closely allied *Dendrobium hispidum* A. Rich. has been reported from the Solomon Islands.  
18. *Dendrobium Tokai* Reichb. f.—San Cristobal Island, Star Harbour, July 3, 1933, Stewart. This species was previously known only from Samoa and the Fiji Islands. The Stewart specimens from the Solomon Islands resemble those from Samoa in shape and size of leaves and size of flowers more than they do those of Fiji. The Fiji specimens all seem larger, with comparatively narrower leaves and larger flowers.  
19. *Dendrobium* sp.—Malaita Island, Tia Bay, June 12, 1933, Stewart. Sterile and scrappy, possibly subgenus *Aporum* of *Dendrobium*.

## PIPERACEAE\*\*

20. *Peperomia pallida* (L. f.) Dietr.—Rennell Island, June 21, 1933, Hynes. Differing from the Polynesian material of this species in its predominantly alternate and larger leaves.

21. **Piper (Eupiper) Fosbergi** Trelease, sp. nov.

Scandens subglabra; folia suboblunga, obtusa vel elliptica, acuminata, nervis pinnatis; spica oppositifolia, bracteis rotundis peltatis.

\* By Louis O. Williams.

\*\* *Peperomia* by T. G. Yuncker, *Piper* by William Trelease.



Scandent, glabrous except for an occasional soft hair on the nerves beneath; flowering internodes rather slender and elongated; leaves suboblong, obtuse, and  $6 \times 16$  cm. to elliptic, acuminate, and  $9 \times 20$  cm., rounded at base with one side shorter, pinnately nerved from below the upper fourth, the nerves some  $9 \times 2$ ; petiole some 10–5 mm. long; spikes opposite the leaves, as yet  $5 \times 55$  mm.; peduncle 1 cm. long; bracts round peltate.

Solomon Islands, Guadalcanal Island, Kau Kau Bay, May 22, 1933, *Stewart* (type). "Vine growing on trees, roots in ground."

This is one of five pinnately nerved species known to me, and is comparable only with two of these, to which I have given manuscript names, both from the Solomon Islands, one from San Cristobal, the other from Guadalcanal.

#### MORACEAE\*

22. *Ficus septica* Burm. f.—Rennell Island, June 20, 1933, *Crocker*.

In my opinion this is referable to *F. septica* Burm. f. which normally has much larger leaves and the fruits borne in the leaf axils. However we have material here [Kew] from the Admiralty Islands showing all intermediates between this material and the normal. The floral structure, also receptacles, leaf venation, etc. of the Rennell Island plant agrees excellently with material of *F. septica* from New Guinea, the Admiralty Islands and the New Hebrides. The group to which the species belongs (§ *Covellia*) often has the receptacles on leafless branches so that the occurrence of these exceptionally in *F. septica* is not surprising.

#### URTICACEAE

23. *Procris pedunculata* Wedd.—Vanikoro Island, Tevia Bay, on trees, May 6, 1933, *Stewart*.

#### AMARANTHACEAE

24. *Achyranthes aspera* L.—Rennell Island, June 21, 1933, *Hynes*.

#### LAURACEAE

25. *Cassytha filiformis* L.—Rennell Island, June 21, 1933, *Hynes*.

#### CAPPARIDACEAE

26. *Capparis sandwichiana* DC. ? Bellona Island, June 30, 1933, *Stewart*.  
This locality is far west of the known range of the species, but there is no obvious difference from Hawaiian specimens.

#### LEGUMINOSAE

27. *Cassia alata* L.—Guadalcanal Island, May 21, 1933, *Stewart*. Native of America.

\* By V. S. Summerhayes.

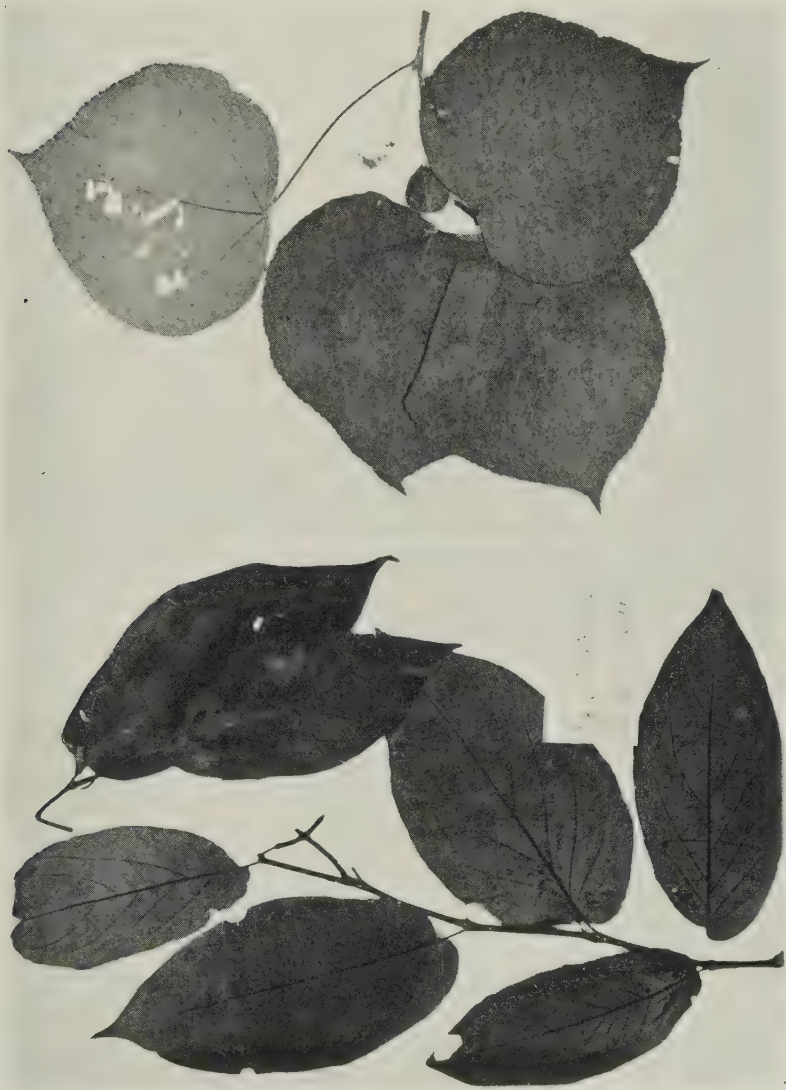


PLATE I

*Acalypha Crockeri* Fosberg, n. sp.

*Piper Fosbergi* Trelease, n. sp.

28. *Pongamia pinnata* (L.) Merr.—Vanikoro Island, May 6, 1933, *Stewart*.  
"A tree 25 feet tall, tide water level."

## RUTACEAE

29. *Evodia hortensis* Forst.—Swallow Group, Mohawk Bay, July 8, 1933, *Stewart*.  
30. *Evodia hortensis* Forst. var. *simplicifolia* Rech.—Swallow Group.  
Mohawk Bay, July 8, 1933, *Stewart*.

## EUPHORBIACEAE

31. ***Acalypha Crockeri*** Fosberg, sp. nov.

Frutex; folia lata, cordata, glabrata, papillosa; stipula lineari-subulata, 5 mm. longa; spica staminata ignota; spica pistillata axillaris, longipedunculata, bracteis hirtellis reniformibus, 9-dentatis; ovaria valde hirtella, 2 mm. longa, subglobosa, stylis 3–5 mm. longis laciniatis.

Branchlets and petioles thin-wooly, leaves broadly cordate, acuminate, about 15 cm. long and wide, thin, strigose on both sides when young, becoming very sparsely so when mature, but with denser patches of hair in the vein axils, minutely but densely papillose on both sides, margin serrate to serrate-crenate, veins palmate near base, pinnate above, secondary veins above the basal ones alternate, petiole up to 11 cm. long, stipules linear-subulate, 5 mm. long; plant probably dioecious, at least only pistillate spikes present on material available, these axillary, long pedunculate, woolly, the whole 7 cm. or longer, peduncle 4 cm., bracts hirtellous, reniform, uniflorous, 2–3 mm. long, strongly toothed, the teeth about 9, acuminate, the central ones longest, these about 1 mm. long; perianth minute, hairy, scale-like, ovary prominently hirtellous, about 2 mm. long, subglobose, styles 3–5 mm. long, conspicuously lacinate distally into many reddish filiform segments; staminate flowers and fruits unknown.

Rennell Island, June 20, 1933, *Crocker* (type).

Closest to *A. novoguineensis* Warb. but leaves broader, serrate, cordate, stipules 4–5 times as long, spikes woolly, bracts slightly larger, more strongly dentate. Close also to *A. grandis* Benth. but differing in leaf shape, much less hairy, spikes shorter, bracts much smaller, more strongly dentate.

Named for the collector of the type and leader of the expedition, Mr. Templeton Crocker.

32. ***Acalypha swallowensis*** Fosberg, sp. nov.

Ramuli tomentosi, sparse hirsuti; folia ovato-cordata, papillosa, nervis infra valde strigosis, petiolis tomentosis, valde hirsutis; stipula lineari-subulata, 5–6 mm. longa; spica staminata ignota; spica pistillata gracilis, 10–11 cm. longa, tomentosa, pedunculata, bracteis hirtellis repandodentatis, unifloris; ovaria hirtella, stylis 5–6 mm. longis, laciniatis.



Branchlets thinly tomentose with scattered long straight spreading hairs; leaves ovate-cordate, up to 17 cm. long and 15 cm. wide, with a few scattered appressed hairs above, veins prominently strigose beneath with the hairs appressed at right angles to the veins, the surface thickly papillose, especially above, secondary veins palmate near the base, pinnate above, blade not noticeably stipellate, petioles up to 9 cm. long, tomentose and prominently soft yellowish-hirsute; stipules linear-subulate, 5-6 mm. long; pistillate spikes slender, 10-11 cm. long, tomentose, peduncle 5 cm. long, bracts repand-dentate, hirtellous, uniflorous, ovary strongly hirtellous, style reddish, filiform-laciniate, 5-6 mm. long; plant apparently dioecious, staminate flowers and fruits unknown.

Santa Cruz Islands, Swallow Group, Mohawk Bay, July 6, 1933, *Stewart* (type).

Differs from *A. neo-caledonica* Müll.-Arg., which it most closely resembles, in the broader leaves, in being much less hirsute on all parts except the petioles, in the more slender pistillate spike, with smaller bracts, and in the much longer styles.

33. *Euphorbia atoto* Forst.—San Cristobal Island, Star Harbour, July 6, 1933, *Stewart*.

34. *Euphorbia serrulata* Reinw.—Rennell Island, June 21, 1933, *Hynes*.

#### MALVACEAE

35. *Hibiscus tiliaceus* L.—Bellona Island, June 29, 1933, *Hynes*.

36. *Sida rhombifolia* L. ?—Bellona Island, June 30, 1933, *Hynes*. Leaves unusually large, ovate, but probably a shade form.

37. *Urena lobata* L.—Rennell Island, June 30, 1933, *Hynes*.

#### MELASTOMACEAE

38. *Medinilla nodosa* Fosberg, sp. nov.

Frutex glaber, nodosus, prostratus; folia opposita, ovata vel elliptica, chartacea, valde trinervata, petiolata; flores axillares, singuli vel bini, pedicellis filiformibus, 2 cm. longis; hypanthium urceolatum; calyx integer; petalae oblongae, tenues, 9-11 mm. longae; stamina subaequalia, 8 mm. longa, filamentis planis tenuibus, antheris supra productis, connectivis crassis; stylus curvatus, leviter crassus, apice integer, recurvatus; bacca multiseminata; semina galeata.

Whole plant glabrous, trailing, rooting at nodes, stems woody, smooth, nodes very prominent, internodes 1-3.5 cm. long; leaves opposite, ovate to elliptical, chartaceous, entire or obscurely crenate-irregular, strongly trinerved, with vestiges of a pair of marginal nerves in larger leaves, blade up to 4 cm. long and 2.5 cm. wide, mostly somewhat smaller, obtuse to rounded at base, acute to (usually) obtuse at apex, petiole slender, about

8-10 mm. long, blade much paler beneath; flowers axillary, solitary or two at a node, pedicel filiform, about 2 cm. long; hypanthium urceolate, 2 mm. high and 2 mm. across, slightly contracted at top, calyx about 0.7 mm. long, somewhat flaring, margin entire but somewhat crispate, at least when dry; petals 4, imbricate in bud, oblong, slightly narrowed at base, rounded at apex, thin, evidently white, 9-11 mm. long, 2-3 mm. wide; the 8 stamens about 8 mm. long, subequal, filaments strap-shaped, wider toward base, thin, with a prominent vascular strand running up the middle, anthers 3 mm. long, apex subulate, enlarged connective thick, only slightly and bluntly projecting behind, obscurely 2-lobed in front; style almost as long as petals, curved, rather fleshy, apex entire, recurved but undifferentiated; fruit a red berry, many seeded, crowned by the flaring calyx, rather truncate at top; seeds obliquely helmet-shaped, yellowish-brown, slightly less than 1 mm. long, somewhat flattened, shiny, but when magnified presenting a minutely hammered appearance, hilum brown, elongate, excavate on both sides.

Guadalcanal Island, Kau Kau Bay, May 20, 1933, *Stewart* (type).

The Melanesian species of this genus are predominantly 4-merous, but are quite diverse in other respects. *M. nodosa* has 4-merous flowers and also resembles several of the others in leaf characters, for example *M. longicy-mosa* Gibbs and *M. parviflora* Gillesp. from Fiji, and *M. tenuipedicellata* Bak. from New Guinea. It resembles these, however, in no other important features. It seems closest to *M. acutifolia* Hemsl. from the Solomon Islands, but differs in that the leaves are not ternate, are usually only 3-nerved, filaments broader, and fruit red instead of white.

#### ARALIACEAE

39. *Polyscias fruticosa* (L.) Harms—San Cristobal Island, Star Harbour, July 6, 1933, *Stewart*.  
Doubtless introduced.

#### ASCLEPIADACEAE

40. *Dischidia melanesica* Fosberg, sp. nov.

Scandens, herbacea, glabra, epiphytica; folia reniformia, disticha, crassa, sessilia; umbella multiflora, axillaris, solitaria, pedunculo robusto, 1.5-2 cm. longo, pulvino bifido, pedicellis crassis, 2 mm. longis; calyx patens vel reflexus, 1 mm. longus; corolla urceolata, 3 mm. longa, lobis erectis, acutis, intus valde villosis, corona esquamata; antherae sagittatae; fructus 5-6 cm. longus, 1 cm. latus, hebes; semina oblonga, 3.5 mm. longa, coma 2.5 cm. longa.

Herbaceous epiphytic closely creeping vine, glabrous (except corolla lobes), stems slender but somewhat fleshy, internodes 4-5 cm. long, each

node producing a pair of leaves and a pair of branching root systems, the latter almost completely covered by the distichous leaves which are borne closely appressed against the substratum; leaves up to 3.5 cm. long and 5 cm. wide, reniform, sessile, evidently rather fleshy, apex very slightly depressed; inflorescences axillary, umbelloid, solitary, peduncle stout, 1.5–2 cm. long, apex a bifid fleshy scaly pulvinus, the branches elongating in age to as much as 1 cm.; flowers rather numerous, pedicels 2 mm. long, fleshy; calyx spreading to reflexed, divided to base, segments triangular acute, about 1 mm. long; corolla ovoid-urceolate 3 mm. long, divided one third the way to base, lobes erect, acute, corolla glabrous outside, tube glabrous within, lobes densely long white-villous within; column 2 mm. high; corona scales absent; anthers sagittate, slightly over 1 mm. long, erect, lower half hard, shiny, yellowish, upper half dark brown when dry, fleshy, apex abruptly obtuse, closely adnate to stigma; fruit a single lanceolate follicle 5–6 cm. long, 1 cm. thick, blunt; seeds brown, oblong, 3.5 mm. long, 1 mm. wide, bearing a loosely attached white silky coma about 2.5 cm. long.

Santa Cruz Islands, Vanikoro, Tevia Bay, May 6, 1933, *Stewart* (type); Solomon Islands, Rennell Island, June 21, 1933, *Hynes*. The latter specimen, though sterile, agrees in every ascertainable respect with the former.

I am not following Blume, Beccari, and Schlechter in separating as a distinct genus those species of *Dischidia* which lack visible corona scales. The scales in *Dischidia* are extremely variable, and their absence in a few species does not seem more significant than certain other variations. Some of the species lacking corona scales seem less closely related among themselves than to various species with such scales. It seems safer to follow Schumann (Nat. Pflanzenf. ed. I, 4 (pt. 2): 288, 1895) who maintains *Dischidia* in a broad sense. *D. melanesica* belongs in his sect. *Conchophyllum* very near to *Conchophyllum papuanum* Schlechter (not *Dischidia papuana* Warb. in Engl. Bot. Jahrb. 18: 205, 1894). If they should prove identical, the correct name in the genus *Dischidia* would be *D. melanesica*.

From *C. papuanum* Schlecht. (ex char.) *D. melanesica* differs in the broader leaves, smaller corolla, with calyx larger in proportion, and especially in that the corolla lobes are long white-villous within while those of *C. papuanum* are merely puberulent. The appendage to the anther does not, in *D. melanesica*, appear hyaline, at least when dry. From *D. imbricata* these two differ in the thinner, more remote leaves, shorter corolla, narrower in proportion, less contracted above, lacking the prominent ring of callosities inside the throat. From *D. depressa* they differ in the larger flowers and the lack of a thickened corona fold on the inside of the corolla. *D. purpurea* and *D. platyphylla* of the Philippines are superficially quite similar, but possess well developed corona scales.



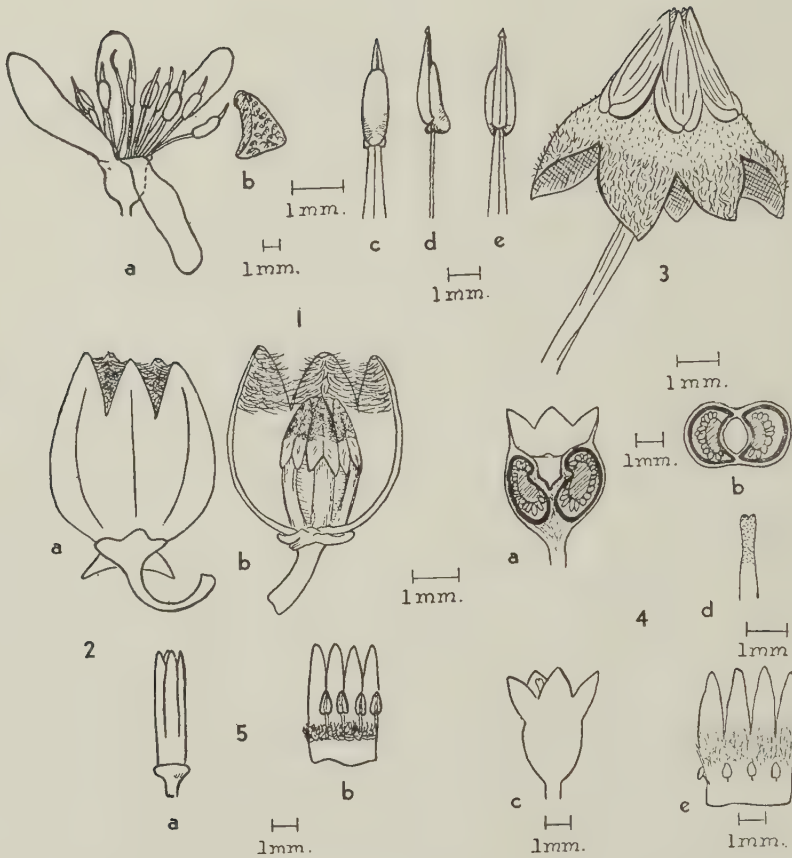


FIG. 1. *Medinilla nodosa*: a. flower; b. seed; c. stamen—dorsal view; d. stamen—lateral view; e. stamen—ventral view. FIG. 2. *Dischidia melanesica*: a. flower; b. flower with one-half of corolla removed. FIG. 3. *Hoya dodecatheiflora*, flower. FIG. 4. *Hedyotis rennellensis*: a. ovary, vertical section; b. ovary, transverse section; c. ovary; d. style; e. corolla, opened. FIG. 5. *Hydnophytum Stewartii*: a. flower; b. corolla, opened.

41. *Hoya affinis* Hemsley—Malaita Island, Uras Cove, May 29, 1933, Stewart.

This specimen checks well with Hemsley's species, except that the corolla is almost glabrous outside, and the sepals are only ciliate, not pubescent outside.

42. *Hoya dodecatheiflora* Fosberg, sp. nov.

Scandens; folia elliptico-lanceolata, crassa, inaequalia, maxime 8 cm. longa; umbella axillaris, multiflora, pedicellis gracilibus, 1 cm. longis; flores 5 mm. longi; calyx minutus; corolla reflexa, valde lobata, intus pubescens, squamis coronae lanceolatis, erectis, sulcatis, 3 mm. longis; pollinia 0.5 mm. longa; carpella 1.2 mm. longa.

Slender vine, glabrous (except corolla), rooting at nodes, internodes 3.5–6.5 cm. long; leaves opposite, elliptic-lanceolate, apex acute to acuminate, base acute, or smaller leaves obtuse, blade fleshy, unequal in size, even at same node, up to 8 cm. long and 2 cm. wide, secondary veins obscure, margin slightly revolute, petiole fleshy, up to 1 cm. long; peduncle axillary, one at a node, up to 9 cm. long, the lower 4–5 mm. fused with petiole of leaf, ending in a simple or bifid fleshy pulvinus, this being the center of a many-flowered umbel of small flowers, pedicels slender, about 1 cm. long; calyx divided almost to base, lobes unequal, ovate or triangular, 0.7–1 mm. long, apex blunt; corolla strongly reflexed, divided more than two thirds to base, lobes sharply triangular slightly acuminate, 2.5 mm. long, tube 1 mm. long, corolla glabrous outside, lobes strongly pubescent inside, tube puberulent inside; corona scales lanceolate, erect, apices prolonged, connivent, bases broader, rounded, deeply notched, surface shining but striate, longitudinally sulcate with two deep folds in the lower portion leading to notch at base, three sharp ridges above, the whole 3 mm. long, pollinia 0.5 mm. long, pale yellow, waxy, the connecting portion dark brown, anthers fused with stigma, carpels 1.2 mm. long, free except the stigmas; whole flower from tip of corona scales and anthers to tips of reflexed corolla lobes about 5 mm. long; fruit unknown.

Santa Cruz Islands, Vanikoro, Tevia Bay, on trees, May 6, 1933, *Stewart* (type).

The flowers of this species resemble superficially those of certain *Solanum* species, or even more so those of the primulaceous genus *Dodecatheon*, hence the name. Not closely related to any species that I have seen.

#### LABIATAE

43. *Coleus scutellarioides* (L.) Benth.—Bellona Island, June 29, 1933, *Hynes*.

44. *Ocimum sanctum* L.—Rennell Island, June 21, 1933, *Hynes*.

#### ACANTHACEAE

45. *Acanthus ilicifolius* L.—Malaita Island, Uras Cove, May 28, 1933, *Stewart*.

This specimen is of the spineless form of this liana, common on older plants, the basis of *A. ebracteatus* Vahl. The spiny form is evidently more common on young plants.

46. *Hemigraphis reptans* (Forst.) Anders.—Rennell Island, June 21, 1933, *Hynes*; Bellona Island, June 30, 1933, *Hynes*. The latter specimen is of a very large leafed form, perhaps from a shady situation.

47. *Pseuderanthemum bibracteatum* Fosberg, sp. nov.

Frutex; folia ovata vel elliptica, acuta vel acuminata, membranacea,

petiolata; bracteae sub paniculis ovatae, truncatae vel cordatae, acutae vel acuminatae; panícula angusta, laxa; calyx 5 mm. longus, lobis 3 mm. longis, linearibus, subulatis; corolla hypocrateriformis, tubo 1-1.5 cm. longo, intra piloso, lobis oblongis, 1 cm. longis, 5-6 mm. latis; fructus 3.5 cm. longus, infra sterilis.

Shrub, stems not sharply 4-angled; leaves ovate to elliptical, up to 18 cm. long and 8 cm. wide, base obtuse and somewhat attenuate, apex acute to acuminate, blade membranous, marked above with an abundance of short linear cystoliths, color not obvious in dried material but probably greenish, mottled with purple above, paler beneath, margin somewhat irregular, main veins 8-10 pairs, petiole up to 4 cm. long; upper pair of leaves subtending inflorescence reduced to broadly ovate, subsessile or shortly petiolate bracts with truncate or cordate base, apex acute or acuminate, up to 10 cm. long and 6 cm. wide; inflorescence a narrow panicle, varying greatly in size, but with cymules rather loose and few-flowered, pedicels as long or longer than the calyx, bracts in inflorescence lanceolate to subulate or the lower leaflike; calyx 5 mm. long, lobes 4 mm. long, linear-subulate, both bracts and calyx glabrous or slightly ciliate; corolla salverform, evidently not strongly oblique, tube 1-1.5 cm. long, 1-1.5 mm. thick, slightly enlarged at base, sparsely pilose inside, lobes about 1 cm. long, 5-6 mm. wide, oblong or obovate, rounded or almost obtuse at apex, ciliate, two pointing upward, two almost horizontal and one downward; anthers exerted, 2 mm. long, curved; fruit as much as 3.5 cm. long, the lower half sterile.

Solomon Islands: Rennell Island and Bellona Island.

This species is closely related to two species, *Ps. kewense* and *Ps. atropurpureum* (names used in the sense of Bailey, Man. Cult. Pl. 702, 1924 and Gentes Herb. 1: 130, 1923, though there is considerable doubt as to the correctness of this application) both unknown except in cultivation, but supposed to have come from the Solomon Islands. It is closest to *Ps. atropurpureum* Bailey, differing in the leaves being less irregular, much thinner, secondary veins more numerous, petiole longer, inflorescence bracts larger below, lanceolate to subulate, rather than ovate, less ciliate; calyx longer, lobes linear subulate rather than lanceolate, less ciliate or glabrous; corolla tube narrower, slightly enlarged at base but not dilated at throat, pilose inside, lobes narrower. Similar to *Ps. kewense* Bailey in the form of the corolla, the pilosity inside the corolla tube, and the ciliate lobes; differing in the reduction of the upper pair of leaves to bracts, in the much shorter corolla tube, broader lobes, of which the two lateral are not directed downward, and in the fewer flowered cymules and longer pedicels. The calyx lobes are much more slender. From the other Melanesian species it differs in the much shorter corolla tube, ciliate lobes, glabrous calyx, as well as many other characters.

To help those interested in forming an opinion as to whether or not the three species discussed above are distinct, or should form varieties of one, their important characters are presented in tabular form:

	<i>Ps. kewense</i>	<i>Ps. atropurpureum</i>	<i>Ps. bibracteatum</i>
Leaves	chartaceous, acuminate	stiff-chartaceous, acute to obtuse, apiculate	membranous, acute to acuminate
Margin	slightly irregular	very irregular	slightly irregular
Upper pair of leaves	not reduced	ovate bracts	broadly ovate or cor- date bracts
Panicle branches	"short, many- and dense-flowered"	looser, 5-8 flowered	looser, 5-8 flowered
Inflorescence bracts	subulate	ovate	lanceolate (or leaflike below)
Pedicels	shorter than calyx	about equal to, or longer than calyx	equal to or longer than calyx
Calyx (length)	4 mm.	3.5-4 mm.	5 mm.
Calyx lobes	lanceolate	lanceolate	linear-subulate
Corolla tube	25 mm. long 1.5 mm. thick pilose inside slightly dilated above	12-13 mm. long 2 mm. thick glabrous inside slightly dilated above and below	10-15 mm. long 1-1.5 mm. thick pilose inside slightly dilated below
Corolla lobes	elliptic, lateral ones directed downward	oval, lateral ones slightly below horizontal	oblong or obovate, lateral ones horizontal
Anthers	2.5 mm. long, straight (?)	1.2-1.8 mm. long slightly curved	2 mm. long, curved

Apparently the question of nomenclature of the two previously described species can not be solved by the application of the present International Rules and it has therefore been submitted to the Committee on Nomenclature for a ruling.

Of *Ps. bibracteatum* two forms exist, evidently growing side by side.

***Pseuderanthemum bibracteatum* f. *typicum* Fosberg, f. nov.**

*Planta typica, caule et foliis glabris.*

Solomon Islands: Rennell Island, June 20, 1933, *Hynes*; Rennell Island, June 21, 1933, *Hynes* (type); Bellona Island, June 29, 1933, *Hynes*.

***Pseuderanthemum bibracteatum* f. *ochraceum* Fosberg, f. nov.**

*A planta typica caule et costis foliorum subtus adpresse hirtello-lanatis differt.*

Solomon Islands: Rennell Island, June 20, 1933, *Crocker*; same loc. and date, *Hynes*; Rennell Island, June 21, 1933, *Hynes* (type); Bellona Island June 29, 1933, *Hynes*.



## GESNERIACEAE

48. *Epithema* sp. aff. *carnosum* Benth.—Rennell Island, June 21, 1933, Hynes.

The specimen is too fragmentary and immature for definite identification.

## RUBIACEAE

49. *Bikkia Pancheri* (Brongn.) Guill.—Rennell Island, June 21, 1933, Hynes.

50. *Geophila herbacea* (Jacq.) Kuntze.—Rennell Island, June 21, 1933, Hynes.

51. *Hedyotis rennellensis* Fosberg, sp. nov.

Planta herbacea vel suffruticosa, praeter nodos floresque glabra; folia oblanceolata; cyma umbellata, geminata, terminalis, pedicellis floriferis 1–2 mm. longis, fructiferis 5 mm. longis; hypanthium turbinatum, 1.5 mm. longum; calycis lobi ovati; corolla glabra vel puberula, 4-mera, in fauci barbata, tubo 2 mm. longo, lobis 2–2.5 mm. longis; antherae infra medio tubo insertae, elliptico-oblongae, 0.7–0.8 mm. longae; stylus 2.5 mm. longus; discus depressus; fructus 2.5 mm. longus, obovoideus, demum dehiscens; semina multa, elliptica, fusca, 0.3–0.4 mm. longa.

Herbaceous or possibly suffrutescent, practically glabrous excepting the flowers and just below the nodes, whole plant marked with short linear or oblong white marks, possibly due to cystoliths; leaves oblanceolate, acute, up to 4.5 cm. long and 7 mm. wide, gradually narrowed at base to a short, winged petiole, secondary veins not at all prominent, 2–3 pairs, upper surface of leaf prominently white marked, under surface less so; stipules interpetiolar, triangular, more or less acuminate, apex blunt, bearing two dark glands, base adnate to petioles, a small portion of stem inconspicuously hirtellous just below each stipule; inflorescence an umbel of 5–8 flowers, umbels borne terminally in pairs, the pairs rarely divided into two pairs, each umbel subtended by two foliaceous bracts, pedicels 1–2 mm. long, increasing in fruit to 5 mm., rather stout; hypanthium turbinate, 1.5 mm. long, glabrous but conspicuously white marked, calyx tube about 0.5 mm. long, lobes ovate, blunt-acute to obtuse, glabrous or minutely ciliolate; corolla tetramerous probably salverform when living, rounded-obtuse in bud, glabrous to strongly papillose-puberulent outside and on inside of lobes, tube about 2 mm. long and wide, lobes 2–2.5 mm. long, broadly oblong-ovate, blunt-acute, tube glabrous inside except at throat where it is very strongly bearded with straight hairs about 1 mm. long; stamens attached below middle of tube, anthers elliptic-oblong, 0.7–0.8 mm. long, dorsifixed about 0.2–0.3 mm. from base, filament 0.7 mm. long; style 2.5 mm. long, slightly emarginate at apex, upper half very minutely puberulent, disk depressed; fruit 2.5 mm. long, obovoid, slightly flattened, sides grooved, edges rounded with a slight ridge below, placentae on an

invagination from the septum somewhat above middle, producing a considerable pit on top of fruit between pyrenes, covered by the depressed disk, pyrenes lightly sclerified, specimens do not show dehiscence, as yet, though seeds are mature; seeds dark sooty brown, ellipsoidal, slightly flattened, 0.3–0.4 mm. long, half as wide, prominently rugulose, very numerous.

Solomon Islands, Rennell Island, June 20, 1933, *Hynes* (type).

This species is closest to *H. albido-punctata*<sup>1</sup> from Micronesia, and through it, related to *H. biflora* and *H. pterita*, widespread Indo-Malaysian species of subg. *Oldenlandia*.

*H. rennellensis* differs from *H. albido-punctata* in the sturdier habit, much longer, oblanceolate leaves, and in the shorter, strictly umbellate, bracteate inflorescences which occur terminally in pairs (instead of few-flowered, loosely paniculate cymes borne terminally in 3's, or reduced to 3-flowered terminal umbels).

## 52. *Hydnophytum Stewartii* Fosberg, sp. nov.

Rami glabri, elongati, crassi; folia elliptica, crassa, petiolata, acuta; stipulae tenues; cymae pulvinatae, maxime 5–7 mm. longae, 3 mm. crassae; flores brevi-petiolati; calyx integer, tubo corollae 1 mm. longo latoque, lobis erectis, oblongis, glabris, 2.3 mm. longis, 0.8 mm. latis, faucibus barbatis; antherae oblongae, 1 mm. longae, filamentis 1 mm. longis; stylus 3 mm. longus, prope basim barbatus, breviter bifidus; drupa ovoidea, 6 mm. longa, 4–5 mm. lata, bipyrenata; pyrenis 4–4.5 mm. longis, 2 mm. latis, vix 1 mm. crassis, plano-convexis, tenuiter sclerosis.

Branches somewhat elongate, weak, fleshy, longitudinally wrinkled when dry, glabrous, internodes 3–4 cm. long, 3–4 mm. thick, nodes thicker, nature of tuberous base unknown; leaves elliptical to slightly ovate or obovate, blade up to 7 cm. long and 2.5 cm. wide, acute or slightly acuminate, base obtuse, petiole flat, up to 5 mm. long and 3 mm. wide, blade glabrous, thick, fleshy, midrib and veins scarcely visible, secondary veins about 4 pairs; stipules thin, rounded, inter- and intrapetiolar, very soon obscured by the inflorescences; inflorescence a pair of fleshy transversely wrinkled and scarred pulvini at each node, one in each leaf-axil, evidently continuously bearing flowers and elongating slowly, so that those about 12 nodes from the apex are 5–7 mm. long and 3 mm. thick; buds becoming quadrangular and tapering, sessile when young, flowers very shortly pedicellate at anthesis, calyx a shallow, entire-margined cup, hypanthium scarcely discernible, corolla tube 1 mm. long, 1 mm. wide, lobes 2.3 mm. long, 0.8 mm. wide, oblong, blunt, glabrous, throat strongly bearded, tube glabrous inside; anthers oblong, about 1 mm. long, basifixed, filaments about 1 mm. long, attached in the sinuses; style 3 mm. long, bearded near

<sup>1</sup> *Hedyotis albido-punctata* (Merr.) Fosberg, comb. nov.—*Oldenlandia albido-punctata* Merrill, Phil. Jour. Sci. Bot. 9: 147, 1914.

the base, shortly divided into 2 somewhat flattened, rounded lobes at extreme apex, disk rounded, about as high as calyx; fruit a red drupe with two pyrenes, drupe 6 mm. long, 4-5 mm. wide, ovoid, crowned with vestigial calyx ring and prominent convex disk, pyrenes in basal  $\frac{2}{3}$  of fruit, 4-4.5 mm. long, 2 mm. wide, less than 1 mm. thick, somewhat plano-convex, with rounded edges, thinly and evenly sclerified; seed with testa thin, rugulose, one end obtuse, the other acute or somewhat umbonate, embryo large, endosperm thin, soft.

Solomon Islands, Guadalcanal Island, Kau Kau Bay, May 22, 1933, *Stewart* (type).

This species, named for the collector, differs from most species of the genus in its extremely short and broad corolla tube, and in the quadrangular, tapering buds. It seems close to *H. Hahlii* Rech. and *H. robustum* Rech., but differs from the former in the more slender stems, petiolate leaves with fewer nerves, much shorter and unbranched inflorescence, and longer stamens with definite filaments. From *H. robustum* it differs in the more slender stems, shorter internodes, petiolate, narrower elliptic acute leaves, fewer and less conspicuous nerves, thinner corolla lobes, shorter stamens, and the fruit not or only slightly constricted below the calyx ring.

Nothing is known as to its relationship with ants, as the tuberous base was not collected.

53. *Morinda citrifolia* L.—Rennell Island, June 20, 1933, *Hynes*.

54. *Mussaenda cylindrocarpa* Burck. ?—Guadalcanal Island, Kau Kau Bay, May 20, 1933, *Stewart*.

Due to the present state of classification, it is impossible to identify *Mussaenda* material of the *M. frondosa* relationship with certainty. Though this collection corresponds fairly well with *M. cylindrocarpa*, it is only with some hesitation that it is referred here in the absence of fruit. The corolla lobes are ovate-acuminate rather than ovate-lanceolate.

#### COMPOSITAE

55. *Adenostemma Lavenia* (L.) Kuntze.—Rennell Island, June 21, 1933, *Hynes*.

56. *Bidens biternata* (Lour.) Merr. and Sherff.—Rennell Island, June 20, 1933, *Crocker*.

57. *Bidens pilosa* L.—Rennell Island, June 29, 1933, *Hynes*.

58. *Vernonia cinerea* Less.—San Cristobal Island, Star Harbour, July 6, 1933, *Stewart*.

59. *Wedelia biflora* (L.) DC.—Rennell Island, June 20, 1933, *Hynes*.

#### FAMILY DOUBTFUL

60. A sterile leafy branch of an unidentified dicotyledonous tree or shrub.—Rennell Island, June 20, 1933, *Hynes*.

## Certain New and Already Known Nematodes from Amphibia and Reptilia

ROBERT J. REIBER, ELON E. BYRD, and MALCOM V. PARKER  
(Department of Zoology, University of Georgia)

Since so little information is available on the nematode parasites of amphibians and reptiles from the southern United States, we have endeavored to make a survey of these hosts for their nematode parasites. Such a survey is of value if for nothing else but host records. Although the work is by no means complete, it seems advisable to publish now the results so far obtained.

The present study is based on a collection of nematodes taken from amphibians and reptiles collected from various localities in Georgia and Florida. Seven of the 15 species collected are new to science and are described under the proposed names: 1. *Oswaldocruzia* (O.) *euryceae* n. sp.; 2. *Kalicephalus floridanus* n. sp.; 3. *Oxysomatium georgianum* n. sp.; 4. *Strongyluris ranae* n. sp.; 5. *Spironoura spiculata* n. sp.; 6. *Spironoura hylae* n. sp.; 7. *Physaloptera variegata* n. sp.

### Family RHABDIASIDAE Railliet, 1915

#### Genus RHABDIAS Stiles and Hassall, 1905

RHABDIAS FASCOVENOSA var. CATANENSIS (Rizzo, 1902) Chu, 1936  
(Pl. I, Figs. 6-8)

*Specific diagnosis*.—*Rhabdias*: Parasitic form. The small oral opening is surrounded by six insignificant lips. The buccal cavity is small and funnel shaped, no teeth could be found. The oesophagus is short ending in a club-shaped swelling posteriorly. The posterior extremity of the body tapers rapidly behind the anus and ends in a fine conical point. The vulva is situated near the middle of the body. There are no marked enlargements or constrictions of the intestine.

Parasitic adult: Body length<sup>1</sup> 3.08 mm.; greatest width 93 $\mu$ ; length of oesophagus 160 $\mu$ ; oesophageal bulb 63 $\mu$   $\times$  45 $\mu$ ; head-nerve ring distance 84 $\mu$ ; head-excretory pore distance 150 $\mu$ ; vulva-tail distance 1.66 mm.; anus-tail distance 164 $\mu$ ; vulva-anterior loop of uterus 980 $\mu$ ; vulva-posterior loop of uterus 1.08 mm.; eggs 54  $\times$  28 $\mu$ .

*Host*: *Thamnophis sirtalis* (Linné) and *Natrix fasciata pictiventris* (Linné).

*Habitat*: Lung.

*Locality*: Melbourne Prairie, Florida, U. S. A.

*Remarks*: *Rhabdias fascovenosa* var. *catanensis* was found in 5 out of 9 *Thamnophis sirtalis* autopsied. The species was recovered only once in

<sup>1</sup> Unless otherwise stated all measurements are given as an average for 10 specimens.



*Natrix fasciata pictiventris*. Both species of snakes came from Melbourne Prairie, Florida.

RHABDIAS RANAE Walton, 1929

(Pl. I, Figs. 3-5)

*Specific diagnosis*.—*Rhabdias*: Parasitic form. The mouth is surrounded by six insignificant lips. The buccal cavity is very short. The oesophagus is slender, terminating in a slightly elongated bulb. The nerve ring is just cephalic to the mid-region of the oesophagus. A pair of indistinct cervical glands lie just in front of the posterior end of the oesophagus. The intestine is dark colored in both the living and preserved material. Three large rectal glands are present. The vulva opens in the posterior half of the body. There are two pairs of post-anal lateral papillae.

Parasitic adult: Body length 6.68 mm.; greatest width  $245\mu$ ; length of oesophagus  $670\mu$ ; head-nerve ring distance  $282\mu$ ; vulva-tail distance 2.23 mm.; vulva-anterior loop of uterus 1.89 mm.; vulva-posterior loop of uterus 1.44 mm.; anus-tail distance  $249\mu$ ; eggs  $52 \times 34\mu$ .

*Host*: *Rana pipiens* Schreber.

*Habitat*: Lung.

*Locality*: Kissimmee, Florida, U. S. A.

*Remarks*: Although these worms are on an average of 2.68 mm. larger than those described by Walton, 1929, it is felt that they are identical. The general external and internal structures conform too closely with the species described by Walton to justify erecting a new species based on our material.

RHABDIAS BUFONIS (Schränk, 1788) Stiles and Hassall, 1905

(Pl. I, Figs. 1 & 2)

*Specific diagnosis*.—*Rhabdias*: Parasitic form. The mouth is surrounded by three small lips. No papillae could be seen. The buccal cavity is characteristically short and funnel shaped. The oesophagus is slender with a

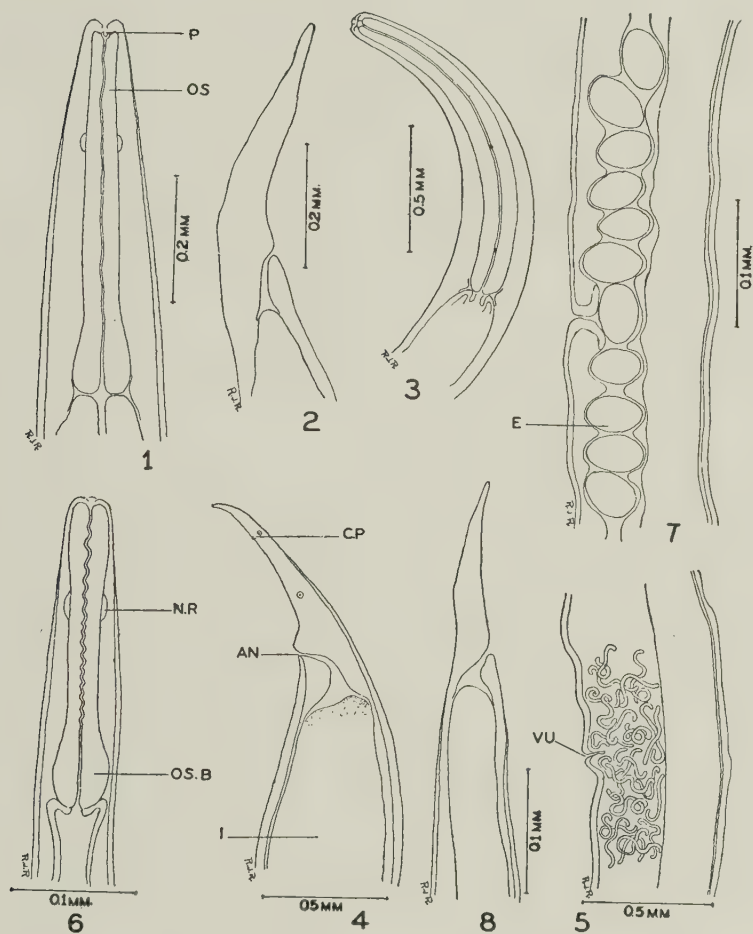
EXPLANATION OF PLATES

Unless otherwise stated all figures were drawn with the aid of a camera lucida.

Abbreviations used:

AN—anus	I—intestine	P—pharynx
B—bursa	I.C—intestinal caecum	P.P—pedunculated papillae
CF.P—cephalic papillae	I.V—intestinal valves	PA.M.—pre-anal musculature
C.P—caudal papillae	L—lip	SP—spicules
CV.P—cervical papillae	L.T—lateral triangular tooth	T.T—tripartite tooth
E—egg	N.R—nerve ring	UT—uterus
E.CH—egg chamber	OS.B—oesophageal bulb	VG—vagina
EX.P—excretory pore	OS—oesophagus	VU—vulva
GB—gubernaculum	OS.V—oesophageal valves	

PLATE I



FIGS. 1-2. *Rhabdias bufonis*. 1. Anterior end; dorsal view. 2. Caudal end; lateral view.

FIGS. 3-5. *Rhabdias ranae*. 3. Anterior end; lateral view. 4. Caudal end; lateral view. 5. Vulva; lateral view.

FIGS. 6-8. *Rhabdias fasciovenosa* var. *calanensis*. 6. Anterior end; dorsal view. 7. Vulva; lateral view. 8. Caudal end; lateral view.

slight bulbular apparatus at the posterior end. The nerve ring is anterior to the mid-region of the oesophagus. The intestine is dark colored and opens by way of a cuticularized rectum to the anus. Three rectal glands are present. A pair of cervical glands, opening just in front of the posterior end of the oesophagus, extends caudad alongside of the intestine. The vulva opens to the outside in the posterior half of the body.

Parasitic adult: Body length 12.96 mm.; greatest width 364 $\mu$ ; length of

oesophagus  $525\mu$ ; oesophageal bulb  $129 \times 83\mu$ ; head-nerve ring distance  $165\mu$ ; head-excretory pore distance (one specimen)  $653\mu$ ; vulva-tail distance  $5.56$  mm.; vulva-anterior loop of uterus  $5.14$  mm.; vulva-posterior loop of uterus  $4.20$  mm.; anus-tail distance  $358\mu$ ; eggs  $78 \times 47\mu$ .

*Host: Bufo fowleri* Hinckley.

*Habitat: Lung.*

*Locality: Watkinsville, Georgia, U. S. A.*

Family TRICHOSTRONGYLIDAE Leiper, 1912

Genus OSWALDOCRUZIA Travassos, 1917

OSWALDOCRUZIA (OSWALDOCRUZIA) WALTONI Ingles, 1936

(Pl. II, Figs. 13-16)

*Specific diagnosis:—Oswaldocruzia.* The cuticular inflation of the head is present but not prominent. There is a greater expansion of the cuticular inflation in the female. Cervical papillae are absent, and there are no papillae in the mouth. The body is marked by numerous closely packed longitudinal cuticular ridges.

Male: Body length  $6.38$  mm.; greatest width  $124\mu$ ; length of oesophagus  $383\mu$ ; cephalic inflation  $42\mu$ ; head-nerve ring distance  $191\mu$ ; head-excretory pore distance  $282\mu$ ; anus-tail distance very short,  $87\mu$ ; length and width of spicules  $209 \times 17\mu$ ; ray formation of bursa copulatrix is characteristic.

Female: Body length  $9.89$  mm.; greatest width  $144\mu$ ; length of oesophagus  $426\mu$ ; cephalic inflation  $63\mu$ ; head-nerve ring distance  $197\mu$ ; head-excretory pore distance  $351\mu$ ; vulva-tail distance  $3.65$  mm.; anus-tail distance  $212\mu$ ; eggs  $56 \times 37\mu$ .

*Host: Bufo fowleri* Hinckley and *Rana pipiens* Schreber.

*Habitat: Small intestine.*

*Locality: Athens, Georgia, U. S. A.*

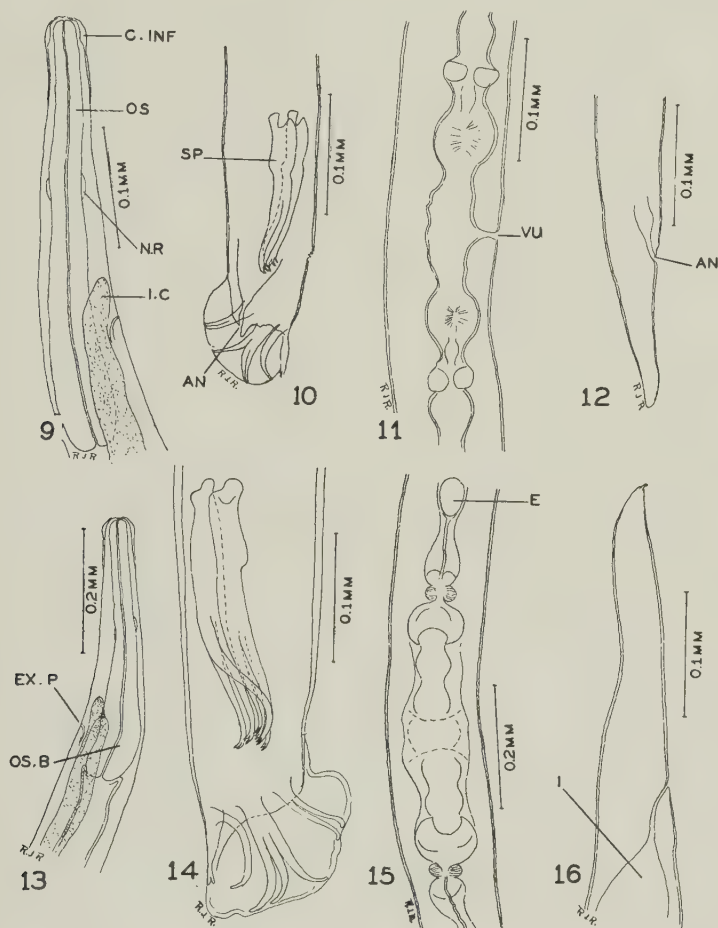
*Remarks: Oswaldocruzia waltoni* was found in *Bufo fowleri* and *Rana pipiens* collected about Athens, Georgia. Those recovered from the first host more nearly conformed to the measurements given by Ingles, 1936, while those taken from the latter host were smaller in size by  $2$  mm. in both sexes. As there were no outstanding differential characters between the present material and that described by Ingles we do not feel justified in establishing a new species for our specimens.

**Oswaldocruzia (Oswaldocruzia) euryceae** sp. nov.

(Pl. II, Figs. 9-12)

Three mature specimens, two males and one female, of an apparently undescribed species of *Oswaldocruzia* were obtained from the small estestine of *Eurycea guttolineata*. A search of available literature reveals this to be the smallest member of the genus yet recorded from North American hosts.

PLATE II



FIGS. 9-12. *Oswaldocruzia euryceae*. 9. Anterior end of female; lateral view. 10. Caudal end of male; lateral view. 11. Vulva; lateral view. 12. Caudal end of female; lateral view.

FIGS. 13-16. *Oswaldocruzia waltoni*. 13. Anterior end of male; lateral view. 14. Posterior end of male; lateral view. 15. Vulva; lateral view. 16. Posterior end of female; lateral view.

*Specific diagnosis*.—*Oswaldocruzia*. The body is characterized by the presence of vascular head swellings (cuticular inflations) which are fairly uniform in both male and female. The general body shows coarse longitudinal striations, about 20 in number, throughout its total length. Both sexes taper gradually cephalad from a cylindrical mid-body region, and the female tapers posteriorly more acutely than does the male, with the body ending in a distinct spike. The head shows no papillae nor are there any cervical papillae in evidence.



Male: Body length 3.25 mm.; greatest width  $78\mu$ ; length of oesophagus  $313\mu$ ; head-nerve ring distance  $165\mu$ ; cephalic inflation length  $41\mu$ ; head-excretory pore distance  $232\mu$ ; anus-tail distance  $51\mu$ ; length and width of spicules  $135 \times 11\mu$ .

Female: Body length 5.69 mm.; greatest width  $95\mu$ ; length of oesophagus  $348\mu$ ; head-nerve ring distance  $174\mu$ ; cephalic inflation length  $75\mu$ ; head-excretory pore distance  $251\mu$ ; vulva-tail distance  $950\mu$ ; anus-tail distance  $135\mu$ ; eggs  $52 \times 34\mu$ .

*Host*: *Eurycea guttolineata* (Holbrook).

*Habitat*: Small intestine.

*Locality*: Macon, Georgia, U. S. A.

*Type specimen*: U. S. Natl. Mus. Helm. Coll. No. 9379.

*Remarks*: This species closely resembles *Oswaldocruzia waltoni* Ingles, 1936, but differs from *O. waltoni* by its much smaller size, the cuticular inflation of the head being of a less magnitude and is not marked by transverse striations, the head being slightly depressed laterally, a fewer number of longitudinal striations on the body, spicules being shorter in length, and the smaller rays of the bursa. The characteristic type dorsal ray pattern of *O. euryceae* is the same as for *O. waltoni*.

#### Family DIAPHANOCEPHALIDAE Travassos, 1919

##### Genus KALICEPHALUS Kolin, 1861

#### KALICEPHALUS TENNESSEENSIS Harwood, 1934

(Pl. III, Fig. 25)

This parasite has been taken from the stomach and oesophagus of *Coluber constrictor constrictor* in fairly large numbers. In other hosts examined this parasite is not found in such abundance. Most of the measurements and the internal structure agree closely, although not totally, with that of *K. tennesseensis* Harwood, 1934, and, although taken from hosts as far south as Florida, the few minor differences encountered herein cannot be regarded as distinctive enough to erect a new species.

*Specific diagnosis*:—*Kalicephalus*. See Harwood, 1934.

Male: Body length 5.64 mm.; greatest width  $224\mu$ ; buccal capsule  $88 \times 42\mu$ ; length of oesophagus  $261\mu$ ; oesophageal bulb  $121\mu$ ; head-nerve ring distance  $187\mu$ ; anus-tail distance  $200\mu$ ; spicule length and width  $449 \times 12\mu$ ; dorsal ray pattern characteristic.

Female: Body length 7.95 mm.; greatest width  $259\mu$ ; buccal capsule  $104 \times 50\mu$ ; length of oesophagus  $293\mu$ ; oesophageal bulb  $141\mu$ ; head-nerve ring distance  $210\mu$ ; vulva-tail distance  $372\mu$ ; anus-tail distance  $276\mu$ ; eggs  $63 \times 29\mu$ .

*Hosts and localities*: *Coluber constrictor constrictor* Linné and *Thamnophis sirtalis* (Linné) from Kissimmee, Florida, *Coluber flagellum flagellum* Shaw

from Athens, Georgia, and *Lampropeltis getulus nigra* (Yarrow) from Columbus, Georgia.

*Habitat*: Stomach and oesophagus.

***Kalicephalus floridanus* sp. nov.**

(Pl. III, Figs. 17-20)

*Specific diagnosis*:—*Kalicephalus*. This is a short, relatively stout worm of a light yellowish color when first taken from the host. The mouth capsule is typical for the genus. The excretory pore is indiscernable. The oesophagus is distinctly thickened at its posterior end with the nerve ring encircling it at its narrowest point, about one-third of the distance from the anterior end. The body of the female is almost cylindrical from the oesophagus to the vulva which is set off by prominent lips. The vulvar ratio is 6.7:1. The bursa is typical for the genus.

Male: Body length 3.97 mm.; greatest width  $170\mu$ ; buccal capsule  $104 \times 50\mu$ ; length of oesophagus  $261\mu$ ; oesophageal bulb  $137\mu$ ; head-nerve ring distance  $179\mu$ ; anus-tail distance  $136\mu$ ; length of spicules  $236\mu$ ; gubernaculum  $84 \times 12\mu$ ; dorsal ray pattern consists of a main ray which bifurcates soon after the separation of the externo-dorsal rays; each inner ray giving off a short lateral ray at its base before becoming bifid near the tip.

Female: Body length 4.60 mm.; greatest width  $217\mu$ ; buccal capsule  $120 \times 54\mu$ ; length of oesophagus  $263\mu$ ; oesophageal bulb  $172\mu$ ; head-nerve ring distance  $200\mu$ ; anus-tail distance  $133\mu$ ; vulva-tail distance  $678\mu$ ; eggs  $63 \times 43\mu$ .

*Host*: *Coluber constrictor constrictor* (Linné).

*Habitat*: Stomach and duodenum.

*Locality*: Kissimmee, Florida, U. S. A.

*Type specimen*: U. S. Natl. Mus. Helm. Coll. No. 9380. Paratype No. 9381.

*Remarks*: These nematodes are the smallest yet recorded for this genus and are always present in large numbers in the stomach and duodenum of the host. The only other species recorded from the same host is *Kalicephalus tennesseensis* Harwood, 1934. The differences between the two are too pronounced to include both in the same species. The total length of *K. floridanus* is smaller by 1.30 mm. in the male, and by  $900\mu$  in the female. The vulva, despite the smaller size of *K. floridanus*, is further forward by  $80\mu$ . The eggs are much smaller in size, which alone is distinctive when considering that *K. tennesseensis*, just half the size of *K. agkistrodontis* Harwood, 1932, has eggs larger than the latter. On the basis of these differences *K. floridanus* n. sp. is here proposed.

## Family OXYURIDAE Cobbold, 1864

## Subfamily COSMOCERCINAE Railliet, 1913

## Genus OXYSOMATIUM Railliet and Henry, 1913

**Oxysomatium georgianum** sp. nov.

(Pl. III, Figs. 21-24)

One male and three females of *O. georgianum* and many immature specimens were found among examples of *Rana pipiens*. Despite the fact that members of this genus are fairly common parasites among amphibians the authors have found only a few specimens at any one time, always with a preponderance of females.

*Specific diagnosis*:—*Oxysomatium*. The body, tapering gradually cephalad and abruptly caudad, is short and stout. The mouth bears three lips, each of which bears two poorly defined papillae. A short muscular pharynx is followed by a longer oesophagus which terminates in a distinct bulb that possesses chitinated cutting plates. The excretory pore, situated just anterior to the oesophageal bulb, is prominent and well developed. The tail in both sexes tapers to a fine point, while that of the male curves sharply ventrally. There are 8 pairs of pre-anal, 2 pairs of ad-anal, and 5 pairs of post-anal papillae. The slender spicules are short and of equal length. A well defined crescentric accessory piece is present. The vulva is located in the posterior half of the body.

Male: Body length 1.47 mm.; greatest width 148 $\mu$ ; length of oesophagus 348 $\mu$ ; oesophageal bulb 71 $\mu$ ; head-nerve ring distance 188 $\mu$ ; head-excretory pore distance 261 $\mu$ ; anus-tail distance 84 $\mu$ ; spicules 137 $\times$ 8 $\mu$ ; accessory piece 67 $\times$ 12 $\mu$ ; papillae arranged as: 8 pre-anal, 2 ad-anal, and 5 post-anal.

Female: Body length 3.02 mm.; greatest width 194 $\mu$ ; length of oesophageal bulb 94 $\mu$ ; head-nerve ring distance 192 $\mu$ ; head-excretory pore distance 272 $\mu$ ; vulva-tail distance 1.27 mm.; anus-tail distance 127 $\mu$ ; eggs 52 $\times$ 26 $\mu$ .

*Host*: *Rana pipiens* Schreber.

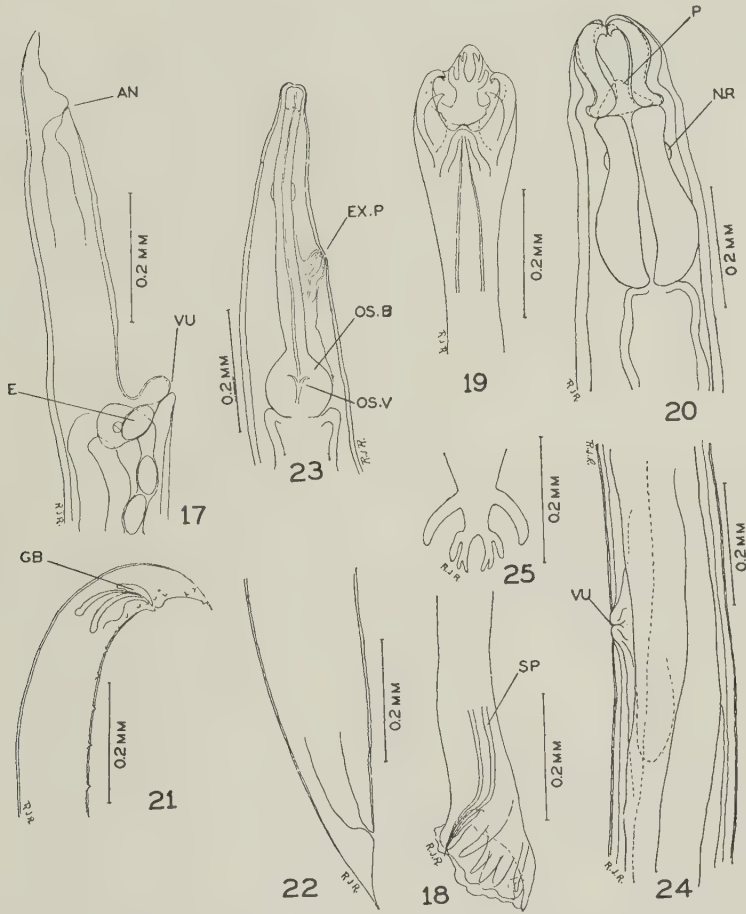
*Habitat*: Rectum.

*Locality*: Greensboro, Georgia, U. S. A.

*Type specimen*: U. S. Natl. Mus. Helm. Coll. No. 9382.

*Remarks*: This species differs from any other described species of *Oxysomatium* in the number and position of anal papillae. Of the numerous forms reported it most closely resembles *O. americana* Walton, 1933, but differs from that species markedly in several respects. *Oxysomatium georgianum* is smaller in the male by 93 $\mu$  and in the female by 1.03 mm.; the oesophagus is longer; the spicules are equal instead of sub-equal; the number of caudal papillae exceeds that of *O. americana* by four pairs.

PLATE III



FIGS. 17-20. *Kalicephalus floridanus*. 17. Posterior end of female; lateral view. 18. Posterior end of male; lateral view. 19. Posterior end of male; ventral view. 20. Anterior end of male; lateral view.

FIGS. 21-24. *Oxysomatium georgianum*. 21. Posterior end of male; lateral view. 22. Posterior end of female; lateral view. 23. Anterior end of male; lateral view. 24. Vulva; lateral view.

FIG. 25. *Kalicephalus tennesseensis*. Dorsal ray of bursa; ventral view.

Family HETERAKIDAE Railliet and Henry, 1914

Genus STRONGYLURIS Muller, 1894

STRONGYLURIS RUBRA Harwood, 1935

*Specific diagnosis*.—*Strongyluris*. The preserved body is opaque, making a study of the internal organs difficult. The mouth is surrounded by three lips which are set off from the body by a marked constriction. In all specimens secured not one of them had the lips protruded, making a study of



the papillae difficult. The papillae and cuticular spikes of the lips could be seen, but no ring of small papillae is evident at their base.

Male: Body length 6.87 mm.; greatest width  $293\mu$ ; cephalic end to caudal end of oesophagus 1.00 mm.; oesophageal bulb  $147\mu$ ; head-nerve ring distance  $351\mu$ ; head-excretory pore distance  $687\mu$ ; anus-tail distance very short; length of spicules  $545\mu$ ; ratio of spicule length to total body length 1:13; length of caudal spike  $27\mu$ .

Female: Body length 8.65 mm.; greatest width  $344\mu$ ; cephalic end to caudal end of oesophagus 1.12 mm.; oesophageal bulb  $142\mu$ ; head-nerve ring distance  $378\mu$ ; head-excretory pore distance  $788\mu$ ; vulva-tail distance 3.60 mm.; anus-tail distance  $268\mu$ ; eggs  $78 \times 43\mu$ .

*Host*: *Sceloporus undulatus* (Latreille).

*Habitat*: Large intestine.

*Locality*: Athens, Georgia, U. S. A.

*Remarks*: In Harwoods description of *Strongyluris rubra* he states that it has only 9 of the usual 10 pairs of caudal papillae, lacking one of the ad-anal pairs. In our material, 4 males and 9 females, we find that all 10 pairs of the caudal papillae are present. These are arranged as follows: 3 pairs of ad-anal, 3 pairs of sub-median post-anal, and 4 pairs of lateral post-anal papillae. As no other outstanding differences could be observed it seemed unwarranted to erect a new species on the basis of this difference alone.

### ***Strongyluris ranae* sp. nov.**

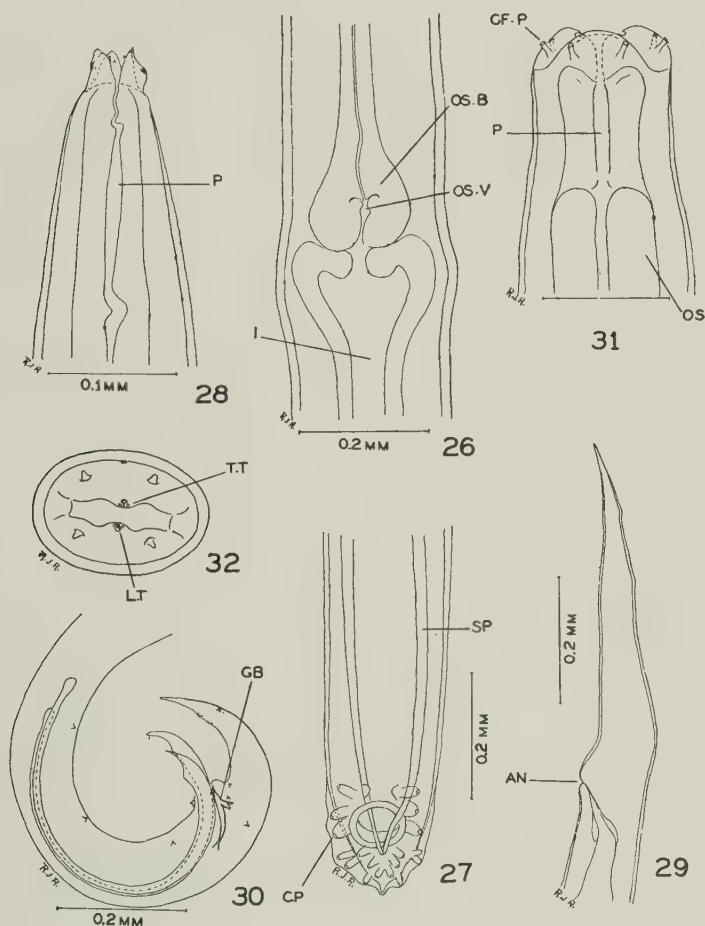
(Pl. IV, Figs. 26-28)

Fourteen specimens of this species were secured from a single *Rana catesbeiana*. In so far as the writers are aware this is the first recorded member of the genus from North America to be taken from an amphibian host.

*Specific diagnosis*:—*Strongyluris*. Body light brown in color in the preserved state. The body, which tapers gradually from the middle to the head, is covered by a thick cuticle marked by extremely fine cross and fine longitudinal striations. The mouth is surrounded by three lips, each set off from the body by a marked constriction. Each lip carries a single papillus and on the inner surface of each may be seen a small forward projecting spike. Somatic papillae were not observed. Behind the mouth is a well developed pharynx which ends in a curve at its junction with the remainder of the oesophagus. The nerve ring is about one-third the length of the oesophagus from the anterior end. The intestine, dark brown in color, is somewhat larger than the oesophageal bulb at its junction with the oesophagus.

Male: Body length 6.55 mm.; greatest width  $293\mu$ ; length of pharynx  $174\mu$ ; length of oesophagus  $870\mu$ ; oesophageal bulb  $168\mu$ ; head-nerve ring distance  $218\mu$ ; length of spicules  $557\mu$ ; with a ratio of 1:13 to the total body length; anus-tail distance  $50\mu$ ; length of caudal spike  $16\mu$ ; caudal alae

## PLATE IV



FIGS. 26-28. *Strongyluris ranae*. 26. Oesophageal bulb; dorsal view. 27. Posterior end of male; ventral view. 28. Anterior end of female; lateral view.

FIGS. 29-31. *Spironoura spiculata*. 29. Posterior end of female; lateral view. 30. Posterior end of male; lateral view. 31. Anterior end of male; dorsal view.

FIG. 32. *Physaloptera variegata*. Head of male; head on view. Diagrammatic.

not very well developed, supported by 10 pairs of caudal papillae, 1 pair of median, sessile pre-anal, 3 pairs of ad-anal, 3 pairs of sub-median post-anal, and 3 pairs of lateral post-anal.

Female: Body length 7.72 mm.; greatest width  $319\mu$ ; length of pharynx  $191\mu$ ; length of oesophagus 1.08 mm.; oesophageal bulb  $179\mu$ ; head-nerve ring distance  $377\mu$ ; head-excretory pore distance  $783\mu$ ; vulva-tail distance 3.41 mm.; anus-tail distance  $216\mu$ ; eggs  $64 \times 35\mu$ .

Host: *Rana catesbeiana* Shaw.

*Habitat*: Large intestine.

*Locality*: Athens, Georgia, U. S. A.

*Type specimen*: U. S. Natl. Mus. Helm. Coll. No. 9383.

*Remarks*: *Strongyluris ranæ* possesses characters of several members of the genus, but resembles more closely *S. brevicaudata* Muller, 1894, from which it differs by possessing cross striations on the cuticle; by the head-nerve ring distance being longer; by the spicules being approximately only one-half as large; and by the arrangement of the caudal papillae. It differs from *S. rubra* Harwood, 1935, in being brownish rather than red in color when taken from the host, in the number of caudal papillae, in the absence of any ring of papillae behind the lips, and in the shorter length of the caudal spike. It differs from *S. media* Harwood, 1935, in possessing cross striations, in the ratio of the spicules to the total body length, in having a shorter caudal spike, and in exhibiting a greater body length.

Family KATHLANIDAE (Travassos, 1918)

Genus SPIRONOURA Leidy, 1856

SPIRONOURA CATESBEIANA Walton, 1929

(Pl. V, Fig. 38)

*Specific diagnosis*.—*Spironoura*. The species is relatively short and slender in body form. Each of the three lips about the mouth bear two internal and two external papillae. The vestibule is short and the pharynx is muscular. The long, muscular oesophagus terminates in a distinct double bulb, each being separated by a neck-like constriction. The tail in both sexes tapers to a fine point, that of the male having a pre-anal musculature extending  $814\mu$  anteriorly where it is specialized to form a single pseudo-sucker-like organ. There are three pairs of pre-anal papillae, 1 median pair of pre-anal papillae, and 7 pairs of post-anal papillae. The spicules are short and broadly alate. A well defined accessory piece is present. The vulva is situated just caudal to the cephalic end of the posterior half of the body.

Male: Body length 4.48 mm.; greatest width  $185\mu$ ; length of pharynx 43; length of oesophagus  $739\mu$ ; head-nerve ring distance  $233\mu$ ; oesophageal bulbs, 1st,  $81 \times 63\mu$ , 2nd,  $137\mu$ ; anus-tail distance  $278\mu$ ; length of spicules  $320 \times 43\mu$ .

Female: Body length 6.16 mm.; greatest width  $214\mu$ ; length of pharynx  $41\mu$ ; length of oesophagus  $801\mu$ ; head-nerve ring distance  $252\mu$ ; oesophageal bulbs, 1st,  $88 \times 76\mu$ , 2nd,  $157\mu$ ; vulva-tail distance 2.37 mm.; anus-tail distance  $459\mu$ ; eggs  $87 \times 49\mu$ .

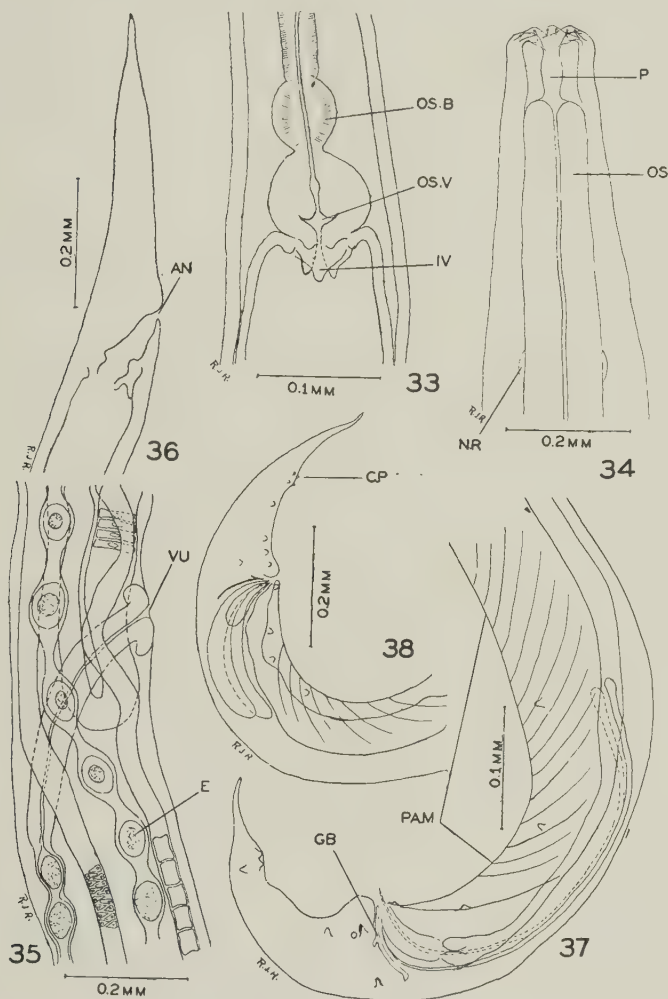
*Host*: *Rana catesbeiana* Shaw.

*Habitat*: Large intestine.

*Locality*: Athens, Georgia, U. S. A.

*Remarks*: About two dozen specimens of this parasite were taken from the Bullfrog. The average measurements of the specimens are slightly

PLATE V



FIGS. 33-37. *Spironoura hylae*. 33. Oesophageal bulbs showing valvular structure; lateral view. 34. Anterior end of female; lateral view. 35. Vulva; lateral view. 36. Posterior end of female; lateral view. 37. Posterior end of male; lateral view.

FIG. 38. *Spironoura catesbeiana*. Posterior end of male; lateral view.

greater than those given by Walton, 1929. External and internal structures, however, agree very closely.

***Spironoura hylae* sp. nov.**

(Pl. V, Figs. 33-37)

*Specific diagnosis*.—*Spironoura*. This is a relatively slender nematode, under the average in length for the genus. The mouth is surrounded by three similar lips, each of which has two external and two internal papillae.



The oesophagus terminates in two distinct spherical bulbs, the anterior being smaller than the posterior, the larger being highly muscular and containing valves. The bulb is followed by the intestine which is dilated at its commencement and contains three well developed intestinal valves. The tail is long in both male and female; the tail of the female being somewhat longer than in the male, gradually tapering to a fine point. The tail of the male is characteristic of the genus, with a conspicuous pre-anal musculature composed of 33 pairs of muscles and a pseudo-sucker,  $348\mu$  long. The pre-anal musculature extends forward for a distance of 1.31 mm. from the anus. The pseudo-sucker is composed of 15 pairs of muscles. There are 10 pairs of caudal papillae: 3 pairs of pre-anal; a single pre-anal papillus, immediately anterior to the anus; 3 pairs of circum-anal; and 4 pairs of post-anal. The three pairs of pre-anal papillae are in a subventral position. The circum-anal papillae are arranged one behind the other, the most anterior being slightly dorsal to the level of the anus and just posterior to the gubernaculum. The remaining two assume a more ventral position. Two pairs of post-anals occur together, one-third of the length of the tail from the tip. Between and dorsal to these two is a lateral pair. The last pair is located on a level just posterior to the level of the anus.

Male: Body length 7.25 mm.; greatest width  $222\mu$ ; length and width of pharynx  $73 \times 38\mu$ ; length of oesophagus 1.06 mm.; oesophageal bulbs, 1st,  $93 \times 70\mu$ , 2nd,  $139\mu$ ; head-nerve ring distance  $291\mu$ ; head-excretory pore distance  $913\mu$ ; anus-tail distance  $323\mu$ ; length of spicules  $804\mu$ ; length of gubernaculum  $141\mu$ .

Female: Body length 8.62 mm.; greatest width  $230\mu$ ; length of pharynx  $73\mu$ ; length of oesophagus 1.16 mm.; oesophageal bulbs, 1st,  $93 \times 70\mu$ , 2nd,  $178\mu$ ; head-nerve distance  $566\mu$ ; anus-tail distance  $573\mu$ ; vulva-tail distance 2.74 mm.; eggs oval,  $83 \times 64\mu$ .

*Host*: *Hyla cinerea cinerea* (Schneider).

*Habitat*: Colon.

*Locality*: Greensboro, Georgia, U. S. A.

*Type specimen*: U. S. Natl. Mus. Helm. Coll. No. 9384.

*Remarks*: This worm closely parallels *Spironoura chelydrae* Harwood, 1932, in many structures but may be distinguished from it by the much shorter spicules, the greater head-nerve ring distance, and the extreme narrow width. A great many differences occur in the measurements of the sizes of various structures between this species and *S. chelydrae* Harwood, but more closely approximates the minimum measurements for the species as given by Mackin, 1936, in his redescription.

### ***Spironoura spiculata* sp. nov.**

(Pl. IV, Figs. 29-31)

*Specific diagnosis*:—*Spironoura*. Body relatively short with a finely cross striated cuticula. The mouth is surrounded by three well defined

lips, each bearing two external papillae and a sharp internal cuticular flange. The oesophagus consists of three parts, a pharynx, a cylindrical mid-portion, and two terminal bulbs; the anterior bulb may be somewhat elongated. The tail in both sexes is sharply pointed. The vulva is situated at the cephalic end of the posterior third of the body. The spicules are equal, their posterior third being sharply alate and from their forward gradually narrowing to assume a rounded shape. A well developed pre-anal musculature extends cephalad for a distance of 1.15 mm. from the anus; it embraces 30 to 35 pairs of muscles. The pseudo-sucker, 326 $\mu$  in length, exhibits 15 to 18 pairs of muscles. There are 10 pairs of caudal papillae: 3 pairs of pre-anal; a single pre-anal papillus, immediately anterior to the anus; 3 pairs of circum-anal; and 4 pairs of post-anal. The three pre-anal papillae are evenly spaced in a sub-ventral position. The circum-anal papillae inscribe a semi-circle just posterior to the anal region, the anterior one being slightly below the level of the anus, anterior to the gubernaculum, and the two posterior pairs just dorsal to the post-anal hump. The two pairs of post-anals occur together near the end of the tail while the two remaining pairs are lateral in position and occur dorsal to the paired post-anals, and slightly anterior to the level of the anus.

Male; Body length 6.85 mm.; greatest width 149 $\mu$ ; length of pharynx 57 $\mu$ ; length of oesophagus 818 $\mu$ ; oesophageal bulbs, 1st, 85 $\times$ 52 $\mu$ , 2nd, 121 $\times$ 105 $\mu$ ; head-nerve ring distance 213 $\mu$ ; head-excretory pore distance 826 $\mu$ ; anus-tail distance 339 $\mu$ ; length of spicules 681 $\mu$ ; length of gubernaculum 108 $\mu$ .

Female: Body length 8.15 mm.; greatest width 191 $\mu$ ; length of pharynx 61 $\mu$ ; length of oesophagus 942 $\mu$ ; oesophageal bulbs, 1st, 89 $\times$ 59 $\mu$ , 2nd, 129 $\times$ 115 $\mu$ ; head-nerve ring distance 244 $\mu$ ; head-excretory pore distance 970 $\mu$ ; vulva-tail distance 3.17 mm.; anus-tail distance 560 $\mu$ ; eggs 92 $\times$ 52 $\mu$ .

*Host*: *Rana grylio* Stejneger.

*Habitat*: Large intestine.

*Locality*: Kissimmee, Florida, U.S.A.

*Type specimen*: U.S. Natl. Mus. Helm. Coll. No. 9385. Paratype No. 9386.

*Remarks*: This species closely approximates in size and in many structures *Spironoura wardi* Mackin, 1936, and *S. concinnae* Mackin, 1936, but is easily distinguished from these by the type of spicules, the length of the gubernaculum, and the nature of the pre-anal musculature.

#### Family ASCARIDAE Baird, 1853

#### Subfamily ANISKINAE Railliet and Henry, 1912

#### Genus DUJARDINIA Gedoelst, 1916

#### DUJARDINIA HELICINA (Molin, 1860) Gedoelst, 1916

(Pl. VI, Figs. 39 & 40)

The material here was recovered from the feces of an Alligator (*Alliga-*

*tor mississippiensis*). Since the specimens had just reached maturity no measurements were attempted.

*Specific diagnosis*:—*Dujardinia*. The posterior of the body is helicoidally twisted with a right hand spiral. The oesophagus is long and narrow, ending in a small bulb. At the point of union between the oesophagus and the intestine the latter structure gives rise to an intestinal caecum that passes anteriorly to lie alongside of the oesophagus. The double pronged pulp of the dorsal lip, the five pairs of pre-anal, the single large pair, and three small pairs of post-anal papillae, the curved tail of the male with a well developed ventral musculature, the slim pointed tail of the female, and the anterior position of the vulva identified the worm as *Dujardinia helicina*.

*Host*: *Alligator mississippiensis* (Daudin).

*Habitat*: Alimentary canal (Stomach?).

*Locality*: Silver Springs, Florida, U.S.A.

Family SPIRURIDAE Orley, 1885

Subfamily PHYSALOPTERINAE Stossich, 1898

Genus PHYSALOPTERA Rudolphi, 1819

***Physaloptera variegata* sp. nov.**

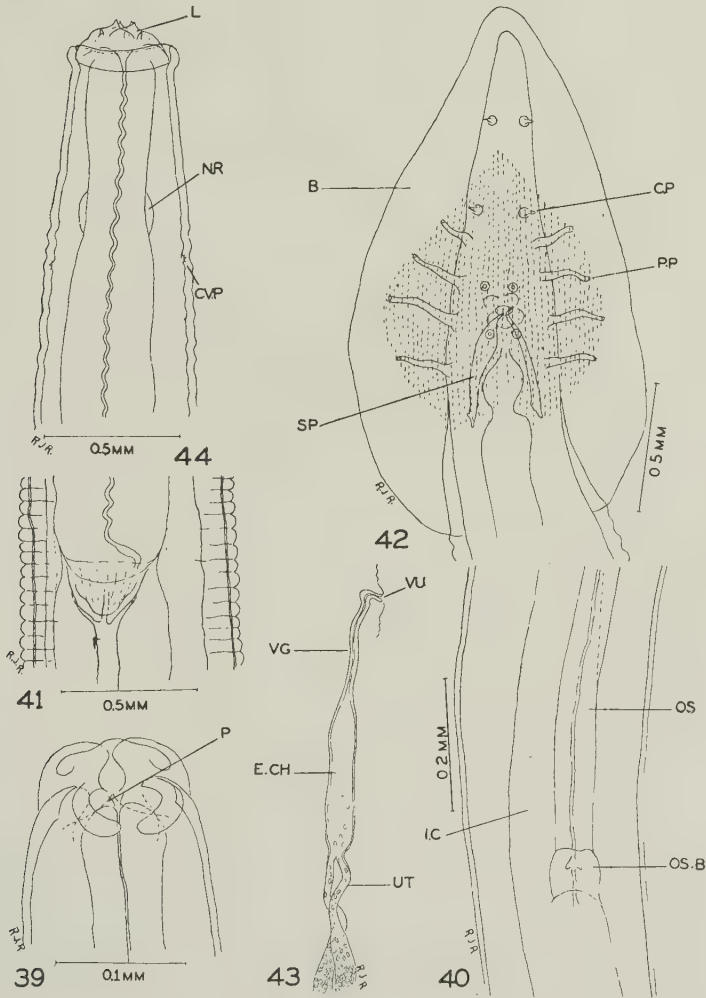
(Pl. IV, Fig. 32 & Pl. VI, Figs. 41-44)

This species occurs in a wide variety of snake hosts within this region. Whenever present it occurred in large numbers, often almost choking the lumen of the stomach.

*Specific diagnosis*.—*Physaloptera*, group "didelphis." Body slender, white in color, with a loosely annulated and finely striated cuticula. Cuticula extending over the lips to form prepuce-like collar. The two lips, lateral in position, are dome shaped and have flattened inner surfaces. Each lip bears a large triangular tooth at its apex, immediately internal to which is a membranous tripartite tooth. Each lip carries on its outer surface two conspicuous papillae. Two cervical papillae are present, situated laterally a short distance behind the cephalic extremity. The nerve ring is located immediately anterior to, and the excretory pore immediately posterior to, the cervical papillae. The oesophagus is subdivided into a short anterior muscular part and a much longer posterior glandular portion.

Male: Body length 18.8 mm.; greatest width 529 $\mu$ ; width of head 105 $\mu$ ; width of collarette 160 $\mu$ ; length of oesophagus 2.86 mm., or one-sixth the total body length; head-nerve ring distance 313 $\mu$ ; head-cervical papillae distance 398 $\mu$ ; head-excretory pore distance 447 $\mu$ ; anus-tail distance 891 $\mu$ . The spicules are subequal and unlike, the long slender spicule may be placed on the right or left side. The broader spicule widens pos-

PLATE VI



FIGS. 39-40. *Dujardinia helicina*. 39. Head of male; dorsal view. 40. Oesophageal bulb and intestinal diverticulum.

FIGS. 41-44. *Physaloptera variegata*. 41. Junction of oesophagus with intestine. 42. Caudal end of male; ventral view. 43. Egg chamber with vagina, vulva, and bases of 2 uteri. Diagrammatic. 44. Anterior end of male; lateral view.

teriorly to about  $41\mu$  in width and then gradually tapers to a point: it is  $275\mu$  long. The slender spicule,  $285\mu$  long and  $28\mu$  broad at its base, tapers gradually to a point, and in all males examined its posterior extremity is recurved. The ventrally curved tail is supported by a well developed cutic-



ular expansion, the ventral surface of which is ornamented by raised longitudinal ridges, and measures 1.43 mm. long by  $696\mu$  wide. There are four pairs of pedunculated caudal papillae situated equidistant from each other, two pairs being pre-anal and two pairs post-anal. The ventral papillae consist of four pairs: 1 pair of pre-anal, just anterior to the cephalic cloacal lip, 1 pair of post-anal, just posterior to the post-cloacal lip, and two pairs evenly spaced between the anus and the tip of the tail.

Female: Body length 21.5 mm.; greatest width  $720\mu$ ; width of head  $165\mu$ ; width of collarette  $252\mu$ ; length of oesophagus 3.44 mm., or one-sixth the total body length; head-nerve ring distance  $330\mu$ ; head-cervical papillae distance  $439\mu$ ; head-excretory pore distance  $459\mu$ ; anus-tail distance  $497\mu$ ; eggs  $42 \times 21\mu$ ; head-vulva distance 5.34 mm. The vagina runs anterodorsad from the vulva for a short distance, thence making a sharp bend caudad and continuing as a narrow canal,  $585\mu$  long by  $67\mu$  wide, after which it expands to form an elongated "egg chamber,"  $855\mu$  long by  $112\mu$  wide. The egg chamber gives rise to two separate tracts which run in a parallel arrangement to near the posterior end of the body. Each tract is clearly differentiated into an ovary, oviduct, seminal receptacle, and uterus.

*Type host:* *Coluber constrictor constrictor* Linné.

*Habitat:* Stomach.

*Type localities:* Kissimmee, Florida, and Greensboro, Georgia, U. S. A.

*Type specimen:* U. S. Natl. Mus. Helm. Coll. No. 9388.

*Remarks:* This nematode has been taken from the following additional hosts: *Thamnophis sirtalis* (Linné) from Kissimmee, Florida, *Coluber flagellum flagellum* Shaw from Athens, Georgia, and *Lampropeltis getulus nigra* (Yarrow) from Columbus, Georgia.

This species may be distinguished from any forms reported among reptiles of this continent by the structure of the caudal region. In the structure of the mouth region it can be distinguished from *Physaloptera phrynosoma* Ortlepp, 1922, by the presence of the inner teeth, from *P. squamatae* Harwood, 1932, by the presence of two external lateral papillae, and from *P. retusa* Rudolphi, 1819, by the larger bursa, the males being only slightly smaller than the females, and the shorter length of the spicules.

#### PHYSALOPTERA sp.

Eight specimens of a nematode belonging to the genus *Physaloptera* were obtained from the stomach and intestine of *Desmognathus fuscus* (Rafinesque) and *Plethodon glutinosus* (Green) from Athens and Macon, Georgia, respectively. An accurate determination of these forms cannot be made at this time since all of our material is immature, however, the general plan of the body permits their inclusion within the genus *Physaloptera*.

## HOST-PARASITE CHECK LIST

Host	Parasite
Amphibia:	
<i>Desmognathus fuscus</i> .....	<i>Physaloptera</i> sp.
<i>Eurycea guttolineata</i> .....	<i>Oswaldocruzia</i> ( <i>Oswaldocruzia</i> ) <i>euryceae</i> n. sp.
<i>Plethodon glutinosus</i> .....	<i>Physaloptera</i> sp.
<i>Bufo fowleri</i> .....	<i>Rhabdias bufonis</i> (Schränk).
<i>Hyla cinerea cinerea</i> .....	<i>Oswaldocruzia</i> ( <i>Oswaldocruzia</i> ) <i>waltoni</i> Ingles.
<i>Rana catesbeiana</i> .....	<i>Spironoura hylae</i> n. sp.
<i>Rana grylio</i> .....	<i>Spironoura catesbeiana</i> Walton.
<i>Rana pipiens</i> .....	<i>Strongyluris ranae</i> n. sp.
	<i>Spironoura spiculata</i> n. sp.
	<i>Rhabdias ranae</i> Walton.
	<i>Oxysomatium georgianum</i> n. sp.
	<i>Oswaldocruzia</i> ( <i>Oswaldocruzia</i> ) <i>waltoni</i> Ingles.
Reptilia:	
<i>Sceloporus undulatus</i> .....	<i>Strongyluris rubra</i> Harwood.
<i>Alligator mississippiensis</i> .....	<i>Dujardinia helicina</i> (Molin).
<i>Coluber constrictor constrictor</i> .....	<i>Kalicephalus tennesseensis</i> Harwood.
	<i>Physaloptera variegata</i> n. sp.
	<i>Kalicephalus floridanus</i> n. sp.
<i>Coluber flagellum flagellum</i> .....	<i>Kalicephalus tennesseensis</i> Harwood.
	<i>Physaloptera variegata</i> n. sp.
<i>Thamnophis sirtalis</i> .....	<i>Rhabdias fascovenosa</i> var. <i>catanensis</i> (Rizzo).
	<i>Kalicephalus tennesseensis</i> Harwood.
	<i>Physaloptera variegata</i> n. sp.
<i>Lampropeltis getulus nigra</i> .....	<i>Kalicephalus tennesseensis</i> Harwood.
	<i>Physaloptera variegata</i> n. sp.
<i>Natrix fasciata pictiventris</i> .....	<i>Rhabdias fascovenosa</i> var. <i>catanensis</i> (Rizzo).

## LITERATURE CITED

- BAYLIS, H. A. On the classification of the Ascaridae. I. The systematic value of certain characters of the alimentary canal. *Parasitology* 12(3): 253-264. 1920.
- On the classification of the Ascaridae. III. A revision of the genus *Dujardinia* Gedoelst, with a description of a new genus of *Anisakinae* from a Crocodile. *Parasitology* 15(3): 223-232. 1923.
- CHU, TSO-CHIK. A revision of the status of the reptilian nematodes of the genus *Rhabdias* with a redescription of *Rhabdias fascovenosa* var. *catanensis* (Rizzo, 1902) new rank. *Jour. Parasitol.* 22(2): 130-139. 1936.
- DAUBNEY, R. Note on the genus *Diaphanocephalus* (Nematoda: Strongylidae), parasitic in reptiles, with a description of three new species. *Parasitology* 15(1): 67-74. 1923.
- HARWOOD, P. D. The helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and vicinity. *Proc. U. S. Natl. Mus.* 81(17): 1-71. 1932.
- Notes on Tennessee helminths. I. *Kalicephalus tennesseensis* n. sp. *Jour. Tenn. Acad. Sci.* 9(3): 192-194. 1934.
- Notes on Tennessee helminths II. Two new species of *Strongyluris* and notes on the genus. *Jour. Tenn. Acad. Sci.* 10(2): 131-141. 1935.

- INGLES, LLOYD G. Worm parasites of California Amphibia. Trans. Amer. Micro. Soc. **55**(1): 73-92. 1936.
- MACKIN, J. G. Studies on the morphology and life history of nematodes in the genus *Spironoura*. Ill. Biol. Monogr. **14**: 7-64. 1936.
- MUELLER, A. Helminthologische Beobachtungen an bekannten und unbekannten Entozoen. Arch. f. Naturg. **60**(1): 113-128. 1894.
- ORTLEPP, M. A. The nematode genus *Physaloptera* Rud. Proc. Zool. Soc. Lond. **1922**(2): 999-1107. 1922.
- TAYLOR, E. L. Notes on some nematodes in the Museum of the Liverpool School of Tropical Medicine. Ann. Trop. Med. and Parasitol. **18**(4): 601-618. 1924.
- WALTON, A. C. A redescription of *Leptodera elongata* Baird, 1858. Ann. and Mag. Nat. Hist. **9**(50): 146-150. 1932.
- Studies on some nematodes of North American frogs. I. Jour. Parasitol. **15**(4): 227-240. 1929.
- The nematodes as parasites of Amphibia. Jour. Parasitol. **20**(1): 1-32. 1933.
- YORK, W. and P. A. MAPLESTONE. The nematode parasites of vertebrates. P. Blakiston's Son & Co. Philadelphia, 536 pp. 1926.

## Development of the Fish Heart

### Brown Trout (*Salmo fario*) and Northern Pike (*Esox lucius*)

FLOYD J. BRINLEY\*

(U. S. Public Health Service, Cincinnati, Ohio)

Previous studies on the innervation of the embryonic teleost and elasmobranch fishes and the action of certain drugs on the heart at various stages of development (Brinley 32, 35, 38) showed that certain drugs such as caffeine has no effect on the rate or amplitude of the heartbeat until about the time the circulation has become well established. This was taken to indicate that the nerves entered the heart at this time and that the action of the drug on the heart was through the nerves and not on the cardiac muscle. However, the question arose as to whether or not there are any morphological changes occurring in the heart muscle during its early development that may increase its susceptibility to the action of the drug and, therefore, afford an explanation of the above results.

A search of the literature revealed several excellent papers (Ziegler—1887, Henneguy—1888, Senior—1909) on the early development of the teleost heart but no detailed report was found on the later development, i.e., from the time contractions begin until the adult condition is obtained.

The present paper deals largely with the gross morphological and histological changes occurring in the heart from the time contractions start until the disappearance of the yolk. Senior, (1909) reports, in his paper on the development of the shad, that the embryos of teleost fishes can be divided into two morphological types depending on the relation of the ventral blood vessel to the yolk. In type I there is an entire absence of blood vessels on the ventral and lateral surfaces of the yolk. Type I, according to Senior, is almost universal in pelagic eggs, but is also found in demersal eggs, including the shad. In type II there is a distinct network of blood capillaries arising from the ventral blood vessel and spreading over the lateral and ventral surface of the yolk. It seems to the present writer, from a study of several species of fish embryos, that type II can be divided into two classes depending upon the distribution of the blood vessels over the yolk and the means by which this blood is returned to the heart. Class No. 1 may be represented by the brown trout embryo, in which the sub-intestinal vein passes through the liver and breaks up into a series of capillaries over the yolk. In the earlier stages, the blood is collected from each side of the yolk and returned to the heart by the right and left vitelline veins. In later stages, the right vitelline vein disappears and all the blood is then collected by one large vein (left vitelline) and returned to the heart. The second class is represented by the northern pike, in which there are no

---

\* Formerly of the North Dakota State College, now of the Stream Pollution Investigations, U. S. Public Health Service, Cincinnati, Ohio.



true capillaries over the yolk and the blood from the ventral blood vessel flows over the yolk sac in a sinus between the ectoderm and mesoderm and enters directly from this sinus into the sinus venosus. Other modifications exist, such as in *Fundulus* where there is a network of capillaries over the yolk but the blood is not collected in a single large vein from the yolk but is returned to the heart by a series of capillaries which join with the sinus venosus. The brown trout and pike were, therefore, selected for study as they represent the two extremes in type No. II.

#### MATERIAL

The eggs of the brown trout and the northern pike were obtained from Minnesota and North Dakota State hatcheries shortly after fertilization, packed in damp moss in thermos jars, and transported to the laboratory by either railway express or carried by car. In the laboratory, the eggs were kept in finger bowls in a refrigerator maintained at a constant temperature of 10°C. Water was changed daily and all dead eggs were removed. Only an occasional egg died after the first few days. (For a detailed description of the care of the eggs in the laboratory, see Brinley, 1937.) The development of the heart and circulation were studied in the living condition and individuals were fixed at definite intervals for sectioning. In order to study the living embryos, it is necessary to remove the chorion with fine dissecting scissors. The yolk and embryo are clear and transparent and the principal blood vessels can be easily followed. Removal of the chorion in no way injures the embryo for they developed normally until the complete consumption of the yolk, at which time the experiments were discontinued. The sectioned material was prepared by removing the chorion, carefully washing out the yolk by making a small slit in the posterior region of the yolk sac and inserting a small glass pipette attached to a hypodermic syringe filled with 0.9% NaCl solution. The yolk is soluble in dilute salt solution but is insoluble in distilled or tap water. The embryos were then fixed in Bouin's solution, sectioned in paraffin and stained with Delafield's haematoxylin and counter stained with eosin. Frontal, cross and sagittal sections were cut 10 $\mu$  in thickness. A series of reconstructions of the heart were made in order to more fully understand the morphological changes and relation of the blood vessels to the heart. These reconstructions were made to scale and magnified 100 diameters.

#### HEART ANLAGE

Henneguy (1888), Ziegler (1887), Oellacher (1872), Swaen and Branchet (1900) have given us a detailed description of early development of the trout heart and as there seems to be a general agreement among these workers in regard to the heart anlage, there is no necessity to repeat their work. The following brief description of the early development of the heart

is taken from the work of these men. Ziegler reports that on the 14th day (temperature not given) when the blastoderm has grown over the yolk (stage H, of Henneguy) and the otic vessel has made its appearance, a mass of mesodermal cells, which lie under the spinal cord, reach out and fuse with the ectoderm, forming a groove and side plates. Two layers can be distinguished and the space between the two is filled with mesoderm. These cells are a part of the unsegmented mass of mesoderm which has migrated from the head region and are located back of the otic vessel. The lower layer of endodermal cells connect with the yolk. Cells migrate from a mass of mesodermal cells lying below the side plates to form a layer of flat elements which is the beginning of the heart epithelium. These cells arrange themselves in such a manner as to form two parallel tubes situated on each side of the median line of the embryo. These combine directly above the parablast to form the heart tube.

### LATER DEVELOPMENT

#### BROWN TROUT

(From the time contraction starts until the adult condition is obtained.)

The heart tube, which has shown no division into chambers, soon flexes so that the lower part, ventricle, is at right angles to the anterior portion or atrium. (Fig. 1.) At this stage, which is about the 27th day after fertilization (constant temperature of 10°C.) the heart shows slow peristaltic contractions beginning in the atrium and passing over the ventricle. The atrium is connected with a large Y shaped sinus which extends into the lateral mesoderm and later forms the sinus venosus. The blood vessels are not well developed nor connected to the heart, so, therefore, no circulation has been established. A few globular, nucleated cells appear in the lumen of the heart and in the region of the dorsal aorta which are probably erythroblasts. As circulation has not been established there is no need for an atrio-ventricular valve, and such does not appear. The walls of the entire heart consist of a single layer of myocardial cells lined with a layer of endocardium. Two days later, 29 days after fertilization, the heart has greatly increased in size; (Fig. 2) the blood vessels have connected with the heart and circulation has been established. This is about the time that the nerves are entering the heart. The two anterior cardinal veins, which return the blood from the head, join on each side with the posterior cardinals to form the duct of Cuvier which pours the blood into the newly formed sinus venosus. The posterior cardinals arise by bifurcation of the caudal vein which returns the blood directly from the dorsal aorta. The blood which has been distributed to the muscle segments of the posterior regions of the body by capillaries from the dorsal aorta is returned to the heart by way of the subintestinal vein. This vein breaks up into capillaries over the yolk and the blood is collected from each side of the yolk by a

vitelline vein which connects with the sinus venosus. No valves appear between the sinus venosus and the atrium. Apparently, the intruding blood from the veins presents a backward flow of blood as the atrium contracts to force the blood through the atrio-ventricular valve into the ventricle. The blood leaves the ventricle through a single valve into the bulbus aortae which continues as the ventral aorta and carries the blood through the different vessels to the gills.

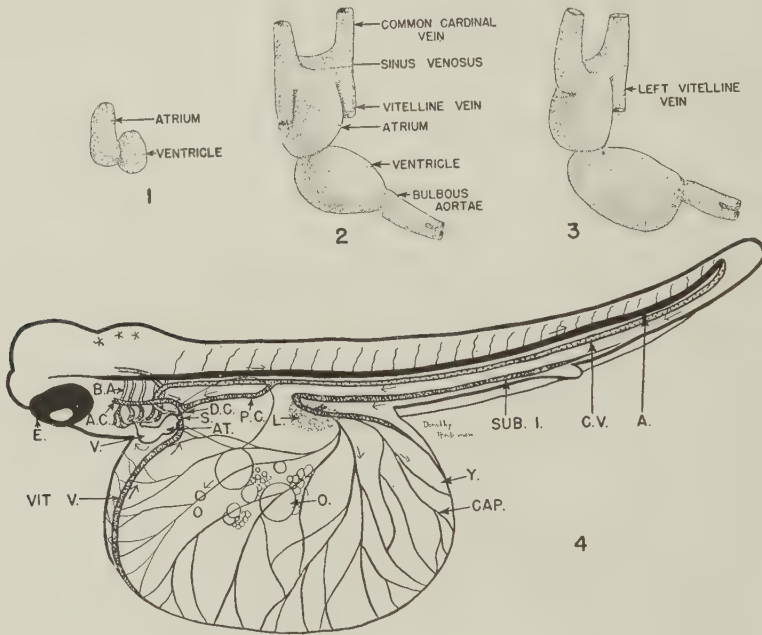


FIG. 1. Drawing of wax reconstruction of heart of trout embryo, 27 days after fertilization.

FIG. 2. Drawing of wax reconstruction of heart of embryo, 29 days after fertilization.

FIG. 3. Drawing of wax reconstruction of heart of embryo, 49 days after fertilization.

FIG. 4. Drawing of trout embryo 49 days after fertilization showing principal blood vessels. E. eye; A.C. anterior cardinal vein; B.A. branchial arteries; V. ventricle; D.C. duct of Cuvier; S. sinus; At. atrium; P.C. posterior cardinal veins; L. liver; A. dorsal aorta; C.V. caudal vein; Sub. I. subintestinal vein; Y. yolk; O. oil droplets; Cap. capillaries; Arrows indicate the direction of the flow of blood.

The entire heart is lined with a single layer of endocardial cells,  $6.4\mu$  in thickness. The wall (myocardium) of the atrium consists of a single layer of large, loosely connected, globular cells, somewhat larger than the endocardial cells. The valve between the atrium and ventricle, which has made its first appearance at this stage, is a simple structure consisting of a fold in the endocardium and a central ingrowth of myocardial cells. The myocardium of the ventricle consists of 3 or 4 layers of cells, about  $19.8\mu$  in thickness and is also lined with a single layer of endocardium. The endo-

cardium continues into and forms the lining of the bulbus aortae. The valve between the ventricle and bulbus aortae appears as a thickening of the endocardium of each side of the tube meeting in a mid-line and appear to function as a sphincter. The general blood circulation is difficult to follow in this stage and as the course of the principal arteries and veins can be studied in the living condition in older stages, they will be described later.

There is no apparent change in the heart until 36 days after fertilization except a slight increase in size ( $9.4\mu$ ) of the cells of the myocardium of the atrium and an additional layer of myocardial cells has appeared in the ventricle. The atrio-ventricular valve becomes thicker by cell multiplication of the endocardium.

Several important changes in the heart occur about 43 days after fertilization; the right vitelline vein is becoming much smaller. All of the blood from the subintestinal vein is carried back to the heart, after it has passed through the developing liver and over the yolk sac, by the left vitelline vein. The right vitelline vein carries only a small amount of blood from the right side of the yolk sac to the heart. In later stages the right vitelline vein completely disappears and all the blood from the yolk is carried to the heart through the left vitelline vein. The atrio-ventricular valve appears as a double layer of endocardial cells, projecting from the side of the orifice, with a central core of myocardium. The single valve between the ventricle and bulbus aortae consists entirely of a fold of endocardium. Many capillaries, filled with erythrocytes, have penetrated the wall of the ventricle and blood can thus pass directly from the ventricular cavity to the myocardium of the ventricle.

Forty-nine days after fertilization, the right vitelline vein has completely disappeared (Fig. 3). The left vitelline vein collects all the blood from the capillaries over the yolk and returns it to the sinus venosus. At this stage the rate of heartbeat is strong and rapid and the course of the principal vessels can be observed in the living embryo (Fig. 4). The blood leaves the ventricle through a well-developed valve, consisting of several layers of endocardial cells, into the bulbus aortae, which is composed of a layer of myocardium, lined with a single layer of endocardium. The blood flows from the bulbus aortae, which shortly bifurcates, and passes through the six afferent branchial arteries (first 2 fused into one, near the base) to the gills. The blood passes from the gills through the efferent branchial arteries, (B.A.), to the dorsal aorta (A), which carries it posteriorly to the tail, giving off numerous capillaries to the various organs and muscle segments along the way. The dorsal aorta makes a U turn at the base of the tail forming the caudal vein (C.V.), which returns the blood directly from the aorta to the heart. The caudal vein divides anteriorly to the liver, forming the two posterior cardinals (P.C.), which join the anterior cardinals (A.C.), forming the duct of Cuvier (D.C.). The blood from the body, which has



come from the aorta by way of the various blood capillaries, is collected by the subintestinal (Sub. I.) vein and carried forward from the tail to the liver (L.). After passing through the liver, the subintestinal vein breaks up into numerous capillaries (Cap.), which spread over the entire yolk (Y.). All of the blood, at this stage, is collected in the anterior portion of the yolk sac by a single large prominent vein, left vitelline (Vit. V.), on the left side of the yolk, and returned to the sinus venosus (S.). In the earlier stages, as previously stated, the blood is collected and returned to the sinus by two vitelline veins, one on each side of the yolk sac. Later, when the yolk is absorbed, the left vitelline forms the hepatic vein. The wall of the atrium is still composed of a single layer of endocardium and myocardium but the cells have increased in size forming a layer  $13.6\mu$  in thickness (endocardium plus myocardium). The thickness of the ventricular wall has increased by cell enlargement to  $27\mu$ . Numerous blood capillaries, filled with erythrocytes, have penetrated the ventricular wall.

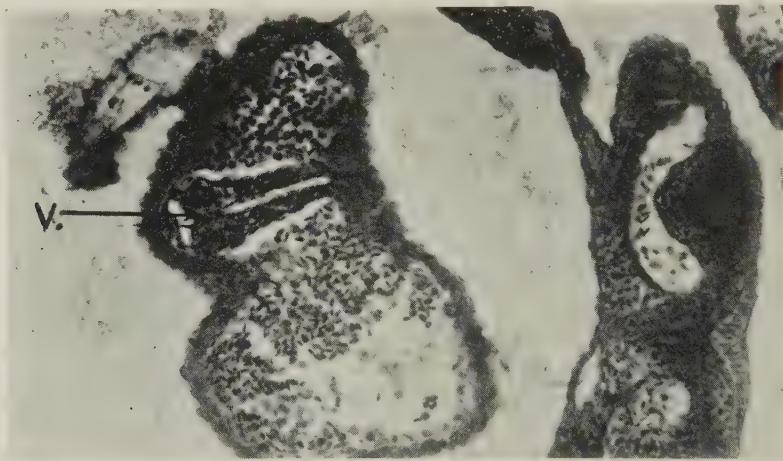


FIG. 5. Photomicrograph, low power, of heart of trout embryo, 76 days after fertilization, showing auricular-ventricular valve, V.

No further change in the development of the heart occurs, except a slight increase in size and a gradual thickening of the wall of the ventricle by cell multiplication and enlargement, until 76 days after fertilization. At this time the yolk sac has greatly diminished in size and the left vitelline forms the hepatic vein which carries the blood directly from the liver to the sinus venosus. A prominent valve (Fig. 5, V.), consisting of two parallel layers of endocardial cells, appears between the atrium and ventricle.

At 86 days the thickness of the ventricular wall has increased to  $47.6\mu$  and a number of mitotic figures appear in the wall of that chamber. The

atrium has not increased in thickness. In 125 days the ventricular wall has increased to  $68\mu$  but no further changes have occurred.

In 139 days the yolk has been completely absorbed and the heart and principal blood vessels have assumed the adult condition. The heart (Fig. 6) has greatly increased in size, and a valve consisting of myocardial cells covered with endothelium has appeared for the first time between the sinus and the atrium. The sinus consists of a single layer of endocardium and myocardium. The wall of the atrium has increased to 3 cells in thickness,  $13.6\mu$ . The myocardial cells in the ventricular wall have arranged themselves in a network of definite strands, but no cross striations have appeared in the muscle fibers. The meshes between the cells are filled with blood capillaries containing erythrocytes. The wall is very thick in the posterior region ( $180\mu$ ) but gradually becomes thinner and cone-shaped as it tapers to the bulbus aortae (Fig. 7). The principal change that has occurred in the circulation (Fig. 8), is that the subintestinal vein (Sub. I.) continues to the liver (L.) and the hepatic vein (H.) formerly the left vitelline vein, runs directly to the sinus (S.).

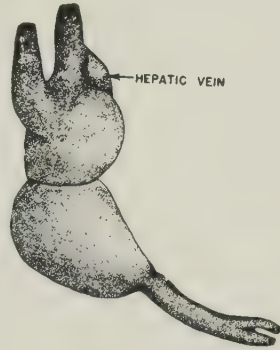


FIG. 6. Drawing of a wax reconstruction of trout heart, 139 days after fertilization.

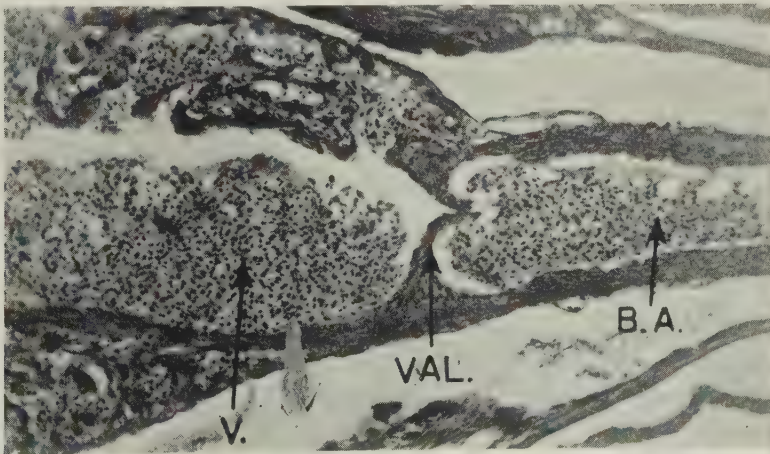


FIG. 7. Photomicrograph, low power, of heart of embryo, 139 days after fertilization, showing valve, VAL. between ventricle, V., and bulbus aortae, B.A.

The rate of growth of the embryonic heart covering the time from the beginning of contraction (27 days) to the complete consumption of the yolk (139 days) is shown in Fig. 9.

## NORTHERN PIKE

As previously stated, the circulation in the embryo of the northern pike differs from that of the trout principally in the way in which the blood flows over the yolk on its return to the heart. There are no well defined

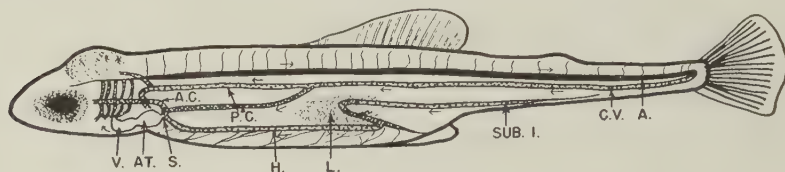


FIG. 8. Drawing of trout embryo 139 days after fertilization, showing principal blood vessels. V. ventricle; At. atrium; S. sinus; A.C. anterior cardinal veins; P.C. posterior cardinals; H. hepatic veins; L. liver; A. dorsal aorta; C.V. caudal vein; Sub. I. subintestinal vein.

blood capillaries over the lateral and ventral surfaces of the yolk and the blood from the posterior region of the body returns to the heart by way of the large blood sinus which completely surrounds the yolk and is formed between the ectoderm and mesoderm. This arrangement, and other changes noted later, produce certain changes in the heart that give quite a different picture from the condition described in the trout embryo.

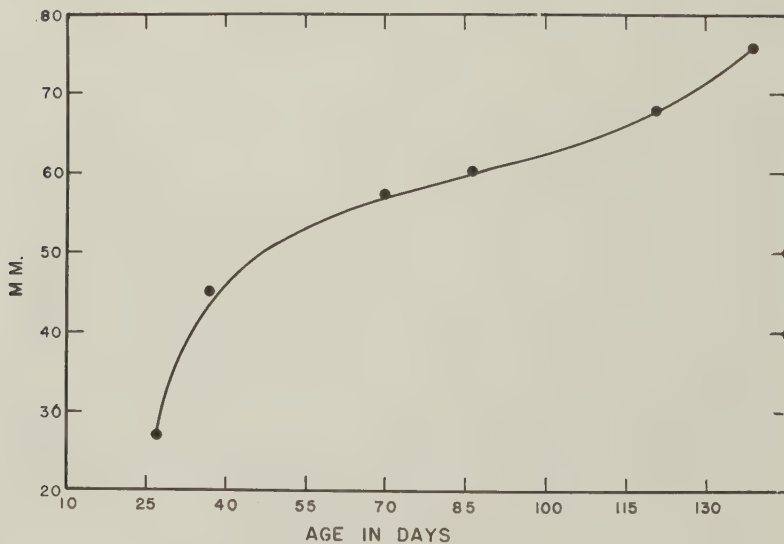


FIG. 9. Graph showing growth of embryonic heart. Abscissa, age in days after fertilization; ordinate, atrial-ventricular length in mm.

The eggs on which these studies were made were obtained from the State Fish Hatchery at Lisbon, North Dakota and were fertilized April 15, 1938. They were kept in the laboratory under the same conditions as previously



described for the trout. On the ninth day after fertilization, the heart shows slow peristaltic contractions but no blood cells have formed and there is no evidence of circulation through that organ. The heart at this stage is a U-shaped tube much as it is in the trout when it starts to beat. The atrium is in direct connection with the anterior region of the blood sinus, which completely surrounds the yolk sac, and is formed between the ectoderm and mesoderm. The walls of the atrium and ventricle are composed of a single layer of myocardium, lined with endocardium. There are a few large globular, nucleated cells present in the heart chambers, which may be erthyroblasts. There is no indication of the presence of the cardinal veins or the duct of Cuvier and the ventral aorta has not yet formed. The heart, therefore, is not connected with any blood vessels, except the blood sinus at the anterior region of the yolk sac. There is no valve between the atrium and ventricle.

There seem to be no important changes except a thickening in the walls of the ventricle until a week later, at which time the cardinal veins have formed and fused to form the duct of Cuvier which connects directly with the blood sinus. The sinus venosus has not yet formed. Circulation has been established but only a few erythrocytes are visible in the blood sinus or in the heart chambers. The only evidence of an atrio-ventricular valve is a thickening in the endocardium at the junction between the atrium and ventricle. The bulbus aortae has developed and the ventral aorta extends forward towards the gills. The wall of the ventricle has increased in thickness to  $30.6\mu$  but the wall of the atrium still consists of a single layer of endocardial and myocardial cells.

Three days later, 21 days after fertilization, the blood circulation is well established and the flow of blood in the larger blood vessels can be observed in the living embryo (Fig. 10). All the blood from the embryo is collected in the blood sinus (S.) at the anterior region of the yolk sac and flows directly from this sinus into the atrium (At.). The blood passes through the atrio-ventricular valve, which has made its first appearance and resembles the same structure in the trout, into the ventricle (V.), then through a valve into the bulbus aortae, and from the ventral aorta to the gills. All of the blood which is distributed to the posterior portion of the body by the dorsal aorta (A.) is returned to the blood sinus, which surrounds the yolk sac, by the caudal vein (C.V.). The blood from the caudal vein does not pass through the liver, as it does in the trout, before returning to the heart, as the liver (L.) is developing in the anterior body cavity, posteriorly and dorsally to the heart. At this stage there is no subintestinal vein as there is in the trout. There is a vein (Ve.), which returns part of the blood from the anterior region to the embryo, that connects with the caudal vein just posterior to the yolk sac. This vein is not found in the trout.

Twenty-five days after fertilization, the yolk has been largely consumed



and part of the blood from the caudal region of the body passes through the liver by way of two hepatic veins into the sinus venosus which has formed from the blood sinus that was connected with the atrium. The rest of the blood from the body is now returned to the sinus venosus by way of a sinus which surrounds the ventral surface of the liver between that organ and the mesodermal layer of body muscles. The duct of Cuvier is connected with the sinus venosus and the single valve between the ventricle and bulbous aorta is well formed and resembles the same structure in the trout heart. The heart has shifted in the pericardial cavity so that the atrium is dorsal and slightly anterior to the ventricle.

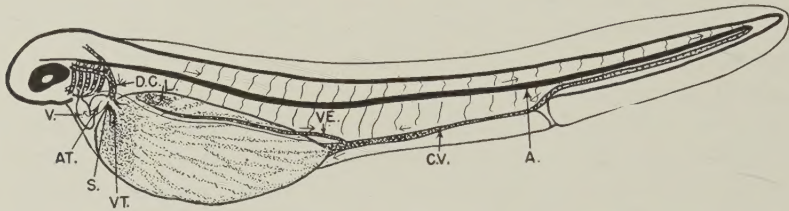


Fig. 10

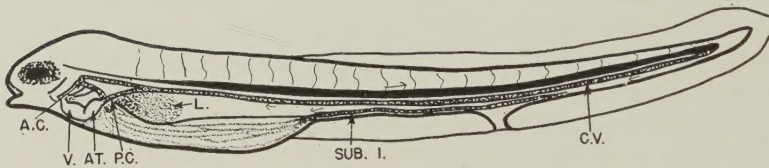


Fig. 11

FIG. 10. Drawing of embryo of northern pike 21 days after fertilization. V. ventricle; At. atrium; S. blood sinus; D.C. duct of Cuvier; A. dorsal aorta; C.V. caudal vein; Ve. vein carrying blood from dorsal region of body cavity to caudal vein; L. liver.

FIG. 11. Drawing of northern pike embryo 40 days after fertilization. Labels same as in Fig. 10. Subintestinal vein, Sub. I., has appeared. A.C. anterior cardinal vein; P.C. posterior cardinal vein.

In thirty days the wall of the ventricle has increased in thickness to  $61\mu$  and the muscle cells have formed into a network of bundles, with the intercellular spaces filled with capillaries which are connected directly with the lumen of the ventricle. The wall of the atrium has not increased in thickness.

On May 25, forty days after fertilization, nearly all the yolk has been absorbed and some important changes have occurred in the general distribution of the larger blood vessels (Fig. 11). The blood from the dorsal aorta is returned to the heart by way of the caudal vein (C.V.). The blood, however, which has been distributed from the dorsal aorta by capillaries to the muscular segments of the tail region, is collected by the sub-intesti-

nal vein (Sub. I.) which has recently made its appearance. Part of the blood from the intestinal vein flows through the blood sinus between the endoderm and mesoderm which surrounds the liver and finally into the sinus venosus. The remainder of the blood passes through the liver (L.), which is located in the anterior region of the body cavity just back of the heart, and by way of the two hepatic veins to the sinus venosus. No further change appears in the heart.

Five days later, all the yolk has been absorbed and the animals become very active and the heart has obtained the general adult condition, except for size. The blood flows into the sinus venosus by way of the duct of Cuvier and from the liver by way of two hepatic veins. All the blood from the intestinal vein now passes through the liver resulting in the complete development of the hepatic-portal system. In the majority of cases the portal vein breaks up into capillaries, but in a few cases it appears as if the portal vein tunnels through the liver and does not break up into capillaries. The wall of the ventricle is composed of a network of muscular bundles with many blood capillaries running through the spaces between the bundles. A single layer of endocardium lines the ventricular cavity. The atrial wall has increased to two or three layers of myocardial cells and the entire heart is lined with a single layer of endocardium. A well developed valve is located between the atrium and ventricle and also a single valve is present between the ventricle and bulbus aortae. These valves seem to be composed entirely of endocardial cells. No valve, however, has appeared between the sinus venosus and the atrium.

#### SUMMARY AND CONCLUSION

A study was made of the development of the heart of two species of fish embryos in order to determine if there are any apparent morphological or histological changes that accompany the ingrowth of the cardiac nerves. Brown trout and northern pike were selected for this study as they represent the two extremes in regard to the distribution of blood vessels over the yolk and the return of the blood to the heart. In the trout embryo there is a network of well defined capillaries over the yolk, and, in the earlier stages, the blood is returned to the heart from the various regions of the body by the anterior and posterior cardinal veins which join to form the ducts of Cuvier. The blood, which passes through the capillaries over the yolk from the subintestinal vein, is collected and returned to the sinus venosus by the right and left vitelline veins. A short time after circulation has been established the right vein disappears and all the blood from the yolk enters the heart through the left vitelline vein. After all the yolk is consumed, the left vitelline vein becomes the hepatic vein and carries blood directly from the liver to the sinus venosus.

In the northern pike, the blood from the caudal vein passes through a



large blood sinus that is formed over the yolk between the ectoderm and mesoderm, and the blood flows directly into the atrium. The ducts of Cuvier connect with the blood sinus. Later, the sinus venosus forms from the anterior region of the blood sinus and after the yolk is consumed, the hepatic-portal system replaces the blood sinus.

The heart has developed into the adult condition by the time the embryo begins to swim. The chambers have increased in thickness and a single valve is present between the atrium and the ventricle and also one between the ventricle and bulbus aorta. A valve, however, is present in the trout between the sinus venosus and the atrium, but this valve has not made its appearance in the larval pike.

No evidence was obtained to indicate that there are any apparent changes in the development of the heart which accompany the ingrowth of nerves.

#### LITERATURE CITED

- BRINLEY, F. J. 1932—A physiological study of the innervation of the heart of fish embryos. *Phys. Zool.* **5**: 527-537.
- 1935—Evidence for a sympathetic innervation of the teleost heart; with a note on a method of transplanting the heart of *Fundulus* embryos. *Phys. Zool.* **8**: 360-373.
- 1937—Eggs of fresh-water fishes suitable for laboratory studies. *Science* **85**: 527-528.
- HENNEGUY, L. F. 1888—Recherches sur le developpement des poissons osseux. *Embryogenie de la truite. Jour. de l'anatomie et de la physiologie* **24**: 413-507, 525-617.
- OELLACHER, J. 1872-'73—Beiträge zur Entwicklungsgeschichte der Knochenfische, nach Beobachtungen am Bachforellenei. *Zeit. f. wiss. Zool.* **23**: 1-115.
- SENIOR, H. D. 1909—The development of the heart in shad with a note on the classification of teleostean embryos from a morphological standpoint. *Am. Jour. Anat.* **9**: 211-262.
- SWAEN AND BRACHET. 1900—Etude sur les premieres phases du developpement des organes dérivées du Mesoblaste chez les poissons Teleostéens. Première partie. *Arch. de Biologie* **16**: 173-311.
- ZIEGLER, E. 1887—Die Entstehung des Blutes bei Knochenfischembryonen. *Archiv. f. mikr. Anat.* **30**: 596-665.